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ABSTRACT

The purpose of this report was to classify and count doctoral scientists in the United States trained in oceanography and/or working in oceanography. Existing data from three sources (National Research Council's "Survey of Earned Doctorates," and "Survey of Doctorate Recipients," and the Ocean Sciences Board's "U.S. Directory of Marine Scientists"), were used to determine the numbers and training of scientists in various ocean science fields, the number of Ph.D.s per year receiving degrees in various fields of ocean science, current employment of oceanographers, and patterns of mobility by trained persons into and out of the ocean sciences. Data analysis is presented under three major headings called: population of doctoral scientists, their education, and demography. Conclusions are drawn and recommendations made relative to the direct training of doctorates in contemporary ocean science, the role of doctorates not obtained specifically in oceanography, the problem of supply and demand, and institutional arrangements and records. (Author/DC)

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Doctoral Scientists in Oceanography

Manpower Trends and Curriculum Needs Panel
Ocean Sciences Board
Assembly of Mathematical and Physical Sciences

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FOREWORD

This report classifies and counts Ph.D. scientists in the United States trained in oceanography, working in oceanography, or both and presents their demography and institutional background. Clear definitions are introduced to avoid problems of ambiguity in dealing with this multifaceted discipline. The numbers presented are rational estimates based on data available from several sources. Although the numerical estimates are therefore not exact, we do believe that they represent a generally credible, quantitative description of the field.

The material in the report is arranged to make a complete picture available for the levels of interest. Chapter 2 is self-contained and designed to serve the needs of most readers. The remaining chapters present additional information and discussion. The model used to estimate population numbers is explained in Chapter 3. The appendixes contain details of the data sources and some of the primary data.

The question of supply and demand, touched upon briefly in Chapter 4, naturally arises in the context of a manpower study. The panel did not, however, make any attempt to estimate quantitatively the future demand for doctoral oceanographers. Even if inclined to do so, further study would have delayed the publication of the present findings, which took considerable time and effort to arrive at. For several years prior to this study, in part because of the very rapid growth of the ocean sciences, no similar information was available for this field. We hope that this report will serve as the basis for permanent and updated records.

Allan R. Robinson, *Chairman*
Manpower Trends and Curriculum
Needs Panel

PREFACE

In the spring of 1977, the Ocean Sciences Board (OSB) of the National Research Council's Assembly of Mathematical and Physical Sciences organized a panel on Ocean Sciences Manpower Trends and Curriculum Needs. In part, the panel was formed because of the length of time since the most recent NRC review of ocean sciences manpower (conducted in 1969 by the Committee on Oceanography). Additionally, a preliminary examination of the limited data available to the Ocean Sciences Board in the fall of 1976 indicated that there may be mismatches between the numbers of, rates of production of, and needs for oceanographers. The panel was asked to obtain credible information on the numbers and training of scientists in various ocean sciences fields in order to determine how and when individuals are trained as ocean scientists; the number of Ph.D.'s per year receiving degrees in various fields of ocean sciences; current employment of oceanographers; and patterns of mobility, that is, persons trained in other fields who are transferring into ocean sciences and those trained in oceanography who moved into other fields.

Initially, the panel membership was composed of Allan Robinson (Chairman), Vera Alexander, John Byrne, Edward Goldberg, and Robert Abel, representing, respectively, physical oceanography, biological oceanography, geological oceanography, chemical oceanography, and marine science education. Later, Morris Hansen and Martha Kohler were appointed to the panel, Hansen to add expertise in the general areas of manpower data and statistics and Kohler to represent industrial oceanographers. Hansen resigned because of conflicting commitments and was replaced in the fall of 1978 by Betty Vetter of the Scientific Manpower Commission.

Following an organizational meeting in April 1977, the panel began to obtain advice and identify data sources. The members corresponded throughout the summer, met again in the fall of 1977 to develop a work plan, and began to obtain primary data on Ph.D. oceanographers during the winter of 1977. With funds provided by the National Science Foundation in the spring of 1978, the panel organized a summer study of the assembled data. This part of the study was conducted by summer interns Shiela Besse and Christina Rushforth under the guidance of Allan Robinson and Richard Vetter. Additional assistance was provided by Muriel Quinones and Peter Syverson, specialists on the NRC Survey of

Earned Doctorates staff, and especially by Andrew Spisak, of the NRC Survey of Doctorate Recipients staff, who served as a special representative member to the panel.

Particular thanks go also to Michael Archambault, then a graduate student at the Department of Oceanography, Texas A&M University, who worked with panel member Robert Abel on special data tabulations of the Survey of Earned Doctorates, which were used during the summer study.

The 1978 summer study indicated that a major effort was needed to examine rigorously the three best sets of data available to the study--the National Research Council's *Survey of Earned Doctorates* and *Survey of Doctorate Recipients* and data from the OSB's *U.S. Directory of Marine Scientists*. These three sets of data, though sampling somewhat different populations, contained the most comprehensive, complete, and intercomparable information available to the panel. All the figures and tables in this report are derived from these three sets of data. The basic data, taken directly from the data sets may be of interest to serious students of ocean science manpower trends. Most of these data are presented in Appendix B. Special tabulations providing other statistical information in these data sets can be obtained, at cost, by contacting the Ocean Sciences Board.

During the fall, winter, and spring of 1978-1979, the panel's Chairman and Executive Secretary (aided by mail and telephone communications with panel members) conducted an exhaustive re-examination and study of the three sets of data. A rigorous and carefully defined terminology was developed to characterize the different subsets of the oceanography doctorate population being studied. Data were rechecked, retabulated, and rearranged to relate better to the criteria imposed by these definitions. Preliminary tables and figures were drawn and redrawn as the relationships between the data sets became clearer. Finally, a rationale was developed that set specific criteria and defined simplifying and rational assumptions that permit intercomparisons among the data sets. That rationale is described in the body of this report. Once the rationale was established, each data set was re-examined, cross checked, and retabulated, and figures were redrawn. We found ourselves exploring a "no-man's land" in terms of our previous experience because we were unable to discover comparable studies elsewhere that could have served as guides.

In September 1979, the Chairman brought together the "core" material for this report, which is presented in detail in Chapters 3 and 4. This material was then distributed to panel members and presented to members of the Ocean Sciences Board for their comments and critiques. A final meeting of the panel was held in November to assemble and agree on the contents of this report and prepare a set of conclusions about the present status of Ph.D. oceanographers, make observations on trends, and outline recommendations for further study. One other product of this study has been a revised questionnaire for the next *U.S. Directory of Marine Scientists* so that future data on ocean science manpower characteristics can be obtained and maintained in a standard fashion.

The financial support from the National Science Foundation made possible the major efforts of the study, the summer study, and subsequent reviews by the panel. Additional support was provided from the general operating funds of the Ocean Sciences Board, to which several other federal agencies contribute. Such support is gratefully acknowledged.

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1. HIGHLIGHTS

A. HIGHLIGHTS

Numbers and Basic Characteristics

o *There were about 2600 doctoral oceanographers in the United States in 1978--approximately four times the number working in this field in 1962. About 30 percent of them earned doctorates in oceanography, while the remainder earned the doctorate in other fields of sciences.*

o The rate of increase of doctoral ocean scientists was larger than for any of the major scientific fields. The total number is now comparable with the number in meteorology or astronomy.

o Fifty percent of the doctoral oceanographers are engaged principally in research; 25 percent in teaching, 15 percent in administration, and 10 percent in other activities.

o Sixty-five percent of doctoral oceanographers in 1978 were employed in academic institutions. The government and its oceanographic laboratories employ about 25 percent, and the remaining 10 percent are employed in industry.

o Oceanographers demonstrate greater intrascience mobility, both into and out of oceanography, than doctoral scientists in any of the major fields, and the proportion of oceanography doctorate holders employed outside of science is less than in any of the major fields.

o About 50 percent of the doctoral oceanographers employed in 1978 were working in biological oceanography: 20 percent each in physical and geological oceanography, and 10 percent in chemical oceanography. However, only a third of those whose doctorates are in oceanography have a subfield concentration in biology, with 29 percent in geology, 23 percent in physics, and 15 percent in chemistry. Among oceanographers whose degrees are in a basic science, one half come from the biological sciences and a third jointly from the earth and physical sciences.

o Oceanography is principally dominated by white males. Only 5 percent of oceanographers are women, although the population of women among recent graduates has risen to about 10 percent. About 6 percent are racial or ethnic minorities, principally Asian American. Non-immigrant foreign nationals have earned about 8 percent of the oceanography doctorates awarded in the United States since 1958.

o Compared with other life and physical scientists, oceanographers are slightly younger, earn somewhat lower salaries, take approximately the same number of years to earn their doctorates, are more likely to be engaged in research, and are less likely to be teaching.

o About 95 percent of working oceanographers are employed in the coastal regions of the United States, including about half on the Eastern seaboard, a third on the West Coast, and a tenth on the Gulf Coast. The remainder work in the Great Lakes region.

Education and Origin

Doctoral Scientists Trained in Other Fields

o Doctoral scientists from other fields now outnumber those with oceanographic degrees by more than 2 to 1. In 1958, four of every five doctoral scientists entering oceanography had earned their doctorate in some other field, generally in one of the basic sciences. By 1978, doctoral entrants were equally divided between those who earned the Ph.D. degree in oceanography and those whose degree was in another field.

o The institutional sources of doctorate holders who enter oceanography from other fields are diverse, so that among all doctoral oceanographers, only 34 percent are from the top nine producing institutions. Six of those nine also appear among the ten major producers of oceanography doctorates.

o Among oceanographers whose doctorates were in another field, more than half (51 percent) earned doctorates in the life sciences, 21 percent in earth sciences, 16 percent in physics, and about 5 percent each in chemistry and engineering. Only 1.5 percent came into oceanography from the social sciences, and less than 1 percent from the mathematical sciences.

Doctoral Scientists Trained in Oceanography

o From 1958 to 1978, a tenfold increase occurred in the number of institutions with active oceanography Ph.D. programs. The growth has been uniform and rapid from about 5 in 1958 to about 50 in 1978. From 1958 to 1976, ten schools awarded 80 percent of all doctorates in oceanography. In 1977, the top ten institutions, which produced 79 percent of the oceanography doctorates, included eight of the top ten in the 18-year production total.

o Among the 1100 persons who earned doctorates in oceanography prior to 1979, approximately 70 percent now work in oceanography--the remainder have moved into other fields. This ratio is fairly consistent for the older as well as the younger doctorates.

o Of those who have left oceanography, about 40 percent now work in the earth sciences, 35 percent in the life sciences, and 5 percent in physics. Less than 2 percent were unemployed and seeking employment in 1977.

o Ph.D.-holding oceanographers are less likely than other scientists to have a bachelor's degree in the field of their Ph.D. degree because oceanography is taught primarily at the graduate level. The proportion of doctoral oceanographers who have master's degrees in the same field is similar to the proportion for other fields of science.

o Until 1973, more oceanography doctorates were awarded in the subfield of geology/geophysics than in any other subfield. Since 1973, biology has been the predominant subfield for oceanography degrees. In 1978, about 42 percent were in this subfield, with 27 percent in physics and 16 percent each in chemistry and geology/geophysics. Because of the long period of domination in the geology/geophysics area, the population of oceanographers with degrees in oceanography included more geological oceanographers than those whose degrees were in any other subfield from 1958 to 1977. By 1978, however, the biological oceanographers in this population slightly outnumbered those in any other subfield.

2. OVERVIEW AND SUMMARY

A. THE OCEAN SCIENCES TODAY

This study is concerned with doctoral scientists in the United States associated with the scientific field of oceanography. The associations of interest include possession of a Ph.D.-level education in oceanography and employment in ocean science. Questions of interest include the origin and growth of the present populations, the inflow and outflow of scientists to and from it, its structure and characteristics, and the implied match or mismatch of this population and its growth to the present and future needs of the science.

Oceanography is a diverse and evolving scientific field that is experiencing a period of rapid growth. The number of doctorate holders employed in oceanography is approximately four times greater today than it was 15 years ago. During this same period, the number of institutions granting Ph.D.'s in oceanography has also quadrupled and the number of such degree holders has multiplied by a factor of 11. There are now over a thousand scientists with doctorates in oceanography, most of whom are numbered among the almost 3000 Ph.D.'s currently employed in ocean science. Fifty-one institutions now have active oceanography programs. Of these, ten grant four fifths of all doctorates awarded in oceanography.

Only a few years ago oceanography was a small field transforming itself from a naturalistic endeavor into a quantitative science. It was the concern of a few Ph.D. holders whose doctoral education was primarily in the basic sciences that define the subfields of ocean science. Today, oceanography is a mature science that ranks in size with such fields as astronomy and meteorology. Its enlarged formal educational structure is now producing as many new doctoral practitioners from its almost entirely recently constructed educational machinery as enter the field from other sources.

The diversity of oceanography is well known. It is constituted from its four major subfields of biological, geological/geophysical, physical, and chemical oceanography. Its scientific problems range from the exploration of peculiarly oceanic phenomena to the investigation of basic scientific processes as they happen to occur in the sea, and many problems are interdisciplinary. The pursuit of ocean sciences problems involves a variety of experimental, observational, theoretical, and modeling techniques and a variety of relevant scientific activities, including, for example, proving mathematical theorems and scuba diving. The boundaries of the science or oceanography are, of necessity, somewhat amorphous and arbitrary. The diversity and complexity of the field, the lack of articulated and generally accepted definitions, and the absence of an inclusive and comprehensive professional overview society or institute contribute both to the necessity and difficulty of this Ph.D.-level manpower study.

B. THE APPROACH AND THE DATA

The approach adopted for the study was to investigate the questions of interest using, for the most part, pre-existing data sources. This approach was adopted for purposes of economy and expediency and in order to provide background information and experience for future studies involving new data acquisition. Thus the specifics of this study are constrained by the information available in the data utilized. Three data sets were chosen as the main basis of our study. These are the National Research Council's *Survey of Earned Doctorates* and *Survey of Doctorate Recipients* and the Ocean Science Board's *Directory of Marine Scientists*. The *Survey of Earned Doctorates* (hereafter referred to as the Annual Census or AC) is an annual record of essentially all the Ph.D. degrees awarded in the United States. The *Survey of Doctorate Recipients* (hereafter referred to as the Biennial Survey or BS) records demographic and professional information obtained from a sample subset of the total pool of existing Ph.D.'s in the United States. The *Directory of Marine Scientists* (hereafter referred to as the *Directory* or DMS) includes information about those scientists employed at institutions involved with marine science and selected for survey by the Ocean Affairs Board (the OSB's predecessor) in 1974 and 1976. To a major extent, the scope of this study--the characteristics of U.S. oceanographers with Ph.D. degrees--was strongly influenced by the availability of good data on Ph.D.'s in these three sets of data.

Ambiquities in the meaning of the terms "oceanography" and "oceanographer" are removed by clearly stated definitions. The panel began with working definitions of terms that were considered pertinent for the study to be undertaken. It then examined the various existing data sets both in terms of these definitions and the individual pragmatic definitions pertinent to each of the data sets. Finally, a set of definitions was adopted that was suitable for our present purposes and consistent with the composite data set on which this study is based. We believe that these definitions can also provide a useful basis for future studies and for a general manpower accounting system in oceanography.

C. CLASSIFICATIONS AND DEFINITIONS

In this section we define the classes of doctoral scientists (DS) analyzed in this report. There are two major classes of interest:

(a) doctoral scientists who are employed in the field of oceanography, i.e., Doctoral Oceanography-Employed Scientists (DOS) and scientists whose doctoral education was in the field of oceanography, i.e., Oceanography-Trained Doctoral Scientists (ODS). These two classes can be further characterized by designating both the fields of their Ph.D. degrees and their employment. Thus a scientist holding a Ph.D. degree in oceanography and currently employed in oceanography is designated an Oceanography-Trained Doctoral Oceanography-Employed Scientist (ODOS). If the field of education or employment is other than oceanography it is simply designated as Alternate (A). For example, a Ph.D. in basic chemistry who switched to chemical oceanography at the postdoctoral level is classified as an Alternately Trained Doctoral Oceanography-Employed Scientist (ADOS).

What constitutes education or employment in oceanography? Factors that enter the determination of the field of the Ph.D. degree are the titles of the degree itself and of the department, program, and institution granting the degree and the curriculum requirements of the Ph.D. program and the substance of the individual program. The panel regards the substantial content of the Ph.D. program to be the factor of dominant importance, but this is difficult to determine from existing data. Virtually all information as to field of degree was obtained from the Annual Census and Biennial Surveys. In the questionnaires of those surveys individuals were asked to check a box beside "field of degree." Thus a Ph.D. degree in oceanography in these two data sets is a degree regarded as such by the individual to whom it was awarded.

Employment in oceanography is determined by the character of the scientific or technical area directly or indirectly affected by the specific work performed and by the broader scientific context in which that work is set. The intention of the panel was to identify doctoral holders engaged more than half time in ocean science activity rather than underlying disciplinary science incidentally carried out in a marine environment, and to exclude ocean engineering. The major data on employment comes from the *Directory of Marine Scientists* questionnaires, which were scrutinized, filtered, and supplemented by the panel (see Appendix A for a discussion of this process). Thus employment in oceanography, as used here in the *Directory*-derived data, means regarded as such by the panel. The Biennial Survey provided independent information on employment because the individuals sampled selected their field of employment from a standard list. Thus, those who selected oceanography are Doctoral Oceanography-Employed Scientists in their own regard. This "perception factor" in the interpretation of definitions of oceanography is an important concept developed more fully in the next chapter.

D. SUMMARY OF RESULTS

In this section we summarize our best estimates of the population characteristics of doctoral scientists in oceanography. The next section describes how these estimates were obtained. The format of presentations was selected to answer the general questions of interest as well as possible with the special information available. The numerical estimates for some of the classes of doctorates are reliable (e.g., Oceanography-Trained Doctoral Scientists), while others are based on approximate or assumed relationships between subclasses or involve extrapolations of the primary data (e.g., Doctoral Oceanography-Employed Scientists) and should be given less credence. The population described in this section is a best-estimate model population (see Chapter 3, Section D) rather than a direct count of the actual population. We regard the estimated population as providing a relevant, accurate, and semiquantitative description of the actual population. The estimated population of doctoral scientists in oceanography who received their Ph.D. degrees in the period from 1958 through 1978 is of the greatest interest and is designated as the "Standard" Population. The production and growth of the "Standard" Population are summarized in Figures 1 through 4. Estimates of the "Total" Population (inclusive of pre-1958 degrees) are presented below, and Figures 5 and 6 display percentage distribution profiles for characteristics of the "Total" population.

Figures 1 and 3 are "production-rate" curves for classes of doctoral scientists. For the Doctoral Oceanography-Employed Scientists (DOS), it should be noted that the production rates are presented in terms of the "Standard" Population as it existed in 1978. An earlier or later population would be expected to have somewhat different production rates because of the movement of working doctoral scientists into and out of oceanography (field switching). For example, the number of doctoral scientists with Ph.D. degrees awarded in 1970 who were working in oceanography in 1978 will differ from the number of 1970-awarded Ph.D.'s who worked in oceanography in 1976. Similar remarks apply to the Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS) and the Oceanography-Trained Alternately Employed Scientists (ODAS) curves of Figure 3. However, in the "Standard" Population, field switching after entering the field was assumed to be a small effect, as were deaths, emigration, and immigration. These factors were ignored in obtaining, by direct integration of the curves in Figures 1 and 3, the "Standard" Population growth curves of Figures 2 and 4. Deaths were ignored because the population of doctoral ocean scientists is dominated by young people as a result of the field's recent rapid growth. An estimate of the likely effect of including a mortality factor in the population model indicated that the probable result of doing so was well below the "noise" level in the data. Field switching before entering the field (i.e., just after obtaining the Ph.D. degree) is significant and was included in the model (See Chapter 3). Field switching after being in the field for some period of time was ignored. We had no data on this effect and could only assume that the overall effect is small, with some oceanographers leaving the field and doctoral scientists from other fields entering it, perhaps for relatively short intervals such as three to five years.

These "Standard" Population growth curves are useful for estimates of the "Total" Population numbers in classes of doctoral scientists for recent years. Although they do not include scientists with Ph.D. degrees awarded before 1958, the number of such DOS is less than 400 in 1978 and, of these, only about 40 were oceanography-trained doctoral scientists (see Table 1). Also, we do not regard the implicit lack of attrition assumption to be quantitatively important for this 21-year period.

As seen in Figure 1, the production rate of Doctoral Oceanography-Employed Scientists (DOS) has increased relatively steadily from 1958 to 1978, doubling from 1964 to 1978. During the 1960's, oceanographers were trained predominantly in the basic disciplines. However, in 1970, when the alternately trained to directly trained production rate ratio was still more than 2 to 1, an important change occurred; the Alternately Trained Doctoral Oceanography-Employed Scientists (ADOS) production rate dropped off, while the Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS) production rate continued to grow. The 1978 production rate of working oceanographers with Ph.D. degrees in oceanography is estimated to equal the rate at which other doctoral scientists enter the field, approximately 80 per year each. The "Standard" doctoral oceanography-employed scientists population numbers (Figure 2) show the population to have doubled in the last 10 years.

In 1968, the ratio of Alternately Trained Doctoral Oceanography-Employed Scientists (ADOS) to Oceanography-Trained Doctoral Oceanography-Employed (ODOS) was almost 4 to 1; it has now diminished to almost 2 to 1. The rate of of production of Oceanography-Trained Doctoral Scientists (ODS) in the "Standard" Population (Figure 3) accelerated rapidly in the mid-1960's and continues to rise. It reached an estimated 115 per year in 1978, of which 80 entered oceanography to become Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODAS) and 35 sought other employment to become Oceanography-Trained Alternately Employed Scientists (ODAS). Figure 4 shows that the total number of oceanography-trained doctoral scientists doubled in the period 1973-1978. The "Standard" Population Model estimates the ratio of Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS) to Oceanography-Trained Doctoral Scientists (ODS) as fixed in recent years at 70 percent.

Figure 7 shows the dramatic increase in the number of institutions producing Oceanography-Trained Doctoral Scientists (ODS). The number with active programs has grown from less than 10 in 1958 to 20 in 1968 and over 40 in 1978, with the largest growth rate still evident in the late 1970's.

We estimate that the "Total" Population Numbers for 1978 ("Standard" + pre-1958) for the basic classes of doctoral scientists are as follows:

Oceanography-Trained Doctoral Scientists (ODS)	1100
Oceanography-Trained Doctoral Alternately Employed Scientists (ODAS)	350
Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS)	750
Alternately Trained Doctoral Oceanography-Employed Scientists (ADOS)	1850
Total Doctoral Oceanography-Employed Scientists (DOS)	2600

Important scientific work is also done by individuals who do not have formal training to the Ph.D. level. Many of them are, in their capabilities and contributions, equivalent to Ph.D.'s. This has been true particularly in the past. Recognizing this, the panel examined the detailed data in the directory (see Appendix A) and identified 265 Ph.D. equivalents. More than half of them had received their highest degree before 1958. Although the scientific contributions of this group are major, omitting them from our tabulations does not significantly affect the conclusions of this report.

Of the 2600 Doctoral Oceanography-Employed Scientists (DOS), about half are in biological oceanography and only 10 percent in chemical oceanography, with the physical and geological subfields sharing the remaining 40 percent equally (Figure 5). Academic employment (65 percent) is dominant, with government second at 25 percent and industry accounting for only 10 percent. Half of the primary work activity is research. One third of the Oceanography-Trained Doctoral Scientists (ODS) (Figure 6) are trained in the biological subfield followed by geological with 29 percent, physical with 23 percent, and chemical with only 15 percent. Of the 30 percent of Oceanography-Trained Doctoral Scientists who do not work in oceanography (ODAS), one third work in the life sciences or the earth sciences.

Demographically, as will be seen in Chapter 5, ocean scientists do not differ substantially from their colleagues in other scientific fields. They show somewhat greater mobility between fields, enter a graduate program from a wider range of baccalaureate backgrounds, and are younger on the average than scientists in other fields. Their pay is somewhat lower, probably because of their lower average age. Although the proportion of women graduates is still small, their numbers are increasing. The proportion of caucasians is high compared with other fields. Only engineering has fewer minority members than the ocean sciences.

E. RESUME OF CONCLUSIONS AND RECOMMENDATIONS

Alternately Trained Doctorates

A major finding of this present study is the leveling off of the entrance rate of alternately trained doctorates in the 1970's and the matching of this rate at the end of the decade by the continually increasing rate of production of oceanography-trained doctorates. Also, the newly acquired body of quantitative scientific fundamentals makes it difficult for alternately trained scientists to enter the field. Although the problem is probably not yet urgent, it is important to recognize that positive action to maintain a healthy flow of alternately trained scientists into the field may require such actions as recruitment, training programs, and the allocation of funds for postdoctoral conversion.

Oceanography-Trained Doctorates

The panel *RECOMMENDS that the Ocean Sciences Board sponsor a curriculum study for the purpose of analyzing programs and contributing to the* *establishment of contemporary guidelines for doctoral degrees in the ocean sciences.* Questions to be addressed include: What is the nature and range of material covered in existing programs? How well does the material relate to fundamental scientific basis of oceanography, to the growing body of specialized knowledge, and to the essential multidisciplinary and interdisciplinary character of many increasingly important central problem areas? How well is the curriculum matched to the professional needs and the potential employment activities of the degree recipients? Are there curricula designed adequately to facilitate intrafield mobility and field switching and applications to environmental and other areas when desired? The panel further *RECOMMENDS that, generally, and for the purposes of the recommended study, the definition of the Ph.D. in oceanography be based on the substance of the curriculum rather than the title of the degree itself or of the department that awards it.*

Supply and Demand

Our findings do not imply at present a general overproduction of oceanography-trained doctorate holders or a saturation or near saturation of the field by this class of doctoral scientist. This remark is based primarily on the alternately trained to oceanography-trained population number ratio and the relatively high degree of field mobility. Moreover, although ocean scientists relative to other scientists are employed predominately in academia, they are engaged there more in research than in teaching. The field appears healthy and to require a strong and diversified curriculum matched both to the evolving science itself and to demands associated with increased societal awareness of marine problems and affairs. These are general observations, and the situation can vary from subfield to subfield depending on factors within the subdisciplines and also from pressures originating in the much larger parent sciences.

In particular, the largest number of doctoral ocean scientists are involved in biological oceanography (including fisheries), and the total teaching activity is greater than in any other subfield. However, at present, the data are not available to indicate that the production rate of biological oceanographers now exceeds the demand. Many biological oceanographers are employed in environmental assessment, either as field workers or as administrators. There is the danger, though, that the demand in this area is only temporary and that this employment market might not be available in the future.

Institutional Arrangements

Ocean science is a newly established, sophisticated, and quantitative modern science comparable in size and some other aspects with meteorology and astronomy. More than 50 institutions now train half of the Ph.D.'s entering the field. Nonetheless, oceanography remains a diverse and complex science whose vitality is crucially supported by advances in the basic sciences upon which it is founded.

Because of rapid growth, recent maturity, and inherent heterogeneity, ocean science does not now have an institutional arrangement adequate and responsible for the oversight functions of record keeping and advocacy generally considered as necessary for scientific fields. What appears to be required is an "oversight" organization responsible for the definition, advocacy, and monitoring of ocean science. It could serve as a forum for discussion of the contents and standards of educational curricula, keep records of manpower and of employment opportunities, and provide authoritative information on career possibilities to prospective oceanographers and on marine scientific issues of interest to the general public. Therefore, the panel *RECOMMENDS that the Ocean Sciences Board undertake a study directed toward the possible establishment of an "oversight" institute for U.S. ocean sciences.*

Records

In view of the size and importance of ocean science today, its rapid growth and evolution, the panel *RECOMMENDS that reliable records be maintained and updated on a regular basis of the population characteristics and numbers of doctoral scientists in oceanography.* At present this should be carried out under the auspices of the Ocean Sciences Board.

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Note Added in Proof Regarding 1979 Data

After this report reached the final stage in its preparation, data became available from the 1979 NRC Survey of Earned Doctorates and the 1979 NRC Survey of Doctorate Recipients. Both sets of data substantiate the conclusions and trends noted in this report. The Survey of Earned Doctorates data indicates a slight (but not statistically significant) decrease in total number of Ph.D.'s awarded in 1979. These data are reported in Appendix B. The Survey of Doctorate Recipients 1977-1979 trends are similar to those noted for 1973-1975 and 1975-1977. These data were received too late for inclusion in Appendix B but can be obtained (at cost) via the office of the Ocean Sciences Board.

3. THE POPULATION OF DOCTORAL SCIENTISTS

This chapter treats the origin and characteristics of classes of doctoral scientists. Exemplary data from the primary sources are presented, the "Standard" Population Model is developed, and population production and growth by scientific subfields are estimated.

A. DATA SOURCES

Here we describe only the most important aspects of the data sets utilized. Details can be found in Appendix A.

The Annual Census (NRC *Survey of Earned Doctorates, Doctorate Records File,* or AC) counts and categorizes almost every Ph.D. degree awarded in the United States. It provides an accurate record of all scientists who received doctorates and checked oceanography or marine sciences/other as their speciality (ODS) but contains little further information of direct interest to this study.

The Biennial Survey (NRC *Survey of Doctorate Recipients* or BS) initiated in 1973 is concerned with the background, status, and characteristics of all present U.S. doctoral scientists and presents information on essentially every question of interest to this study. Unfortunately, the small sample size for the "fine" field of oceanography results in large uncertainties. The Biennial Survey is conducted with a sample of known doctorate recipients chosen so that acceptably accurate information will be obtained for specified population groups. One such group is the broad field of earth sciences with ocean science (oceanography and marine science/other) as a "fine" field. Estimates of the "fine" fields are not so precise as estimates of the broad fields. Thus, caution is necessary in the interpretation of "fine" field estimates; and, in particular, information involving further breakouts within the "fine" field of oceanography (e.g., oceanographic scientific subdisciplines) and changes occurring from one survey to the other (1973, 1975, 1977) are generally not credible because uncertainities in the numbers will usually exceed the differences of interest.

The third major source of data was the questionnaires used to prepare the OSP's *U.S. Directory of Marine Scientists*. These contain information on the employees of approximately 220 academic and state institutions and 90 federal agency laboratories to which they were sent in 1974 and 1976. They are an excellent source of information on the activity and scientific subfields of working scientists and of their educational level and institutional origin, but they do not contain information on the field of the Ph.D. degrees. Further, they provide an accurate counting only of individuals who received their doctorates prior to 1973. The panel examined the employment subfields of the Directory Ph.D.'s and selected those belonging to ocean science rather than engineering or related science. Because the Directory survey was known to be deficient in its coverage of industrial oceanographers, the panel requested supplemental information from about 100 industrial companies in 1978 and received 45 replies. On the basis of information from that survey and corroborative data from the NRC Biennial Surveys, the numbers of Doctoral Oceanography-Employed Scientists (DOS) in the Directory-derived data set were increased by about 10 percent to account for the DOS believed to be in the industrial sector. The resultant data are considered as the Modified Directory of Marine Sciences Data (DMS).

B. NOTATION

Because of the need to define rigorously the various classes of doctoral ocean scientists and because the full descriptive titles for the many classes are too long to use in tables and figures, we have developed a system of notation for this report. In this system, the letter preceding the D (for Doctoral) designates the field of training of the Ph.D. and the letter following D designates the field of employment. It was necessary to distinguish further within the class of individuals that the panel considers to be Doctoral Oceanography-Employed Scientists (DOS) by identifying the subclass consisting of those who perceive of themselves as working oceanographers and the subclass of those who perceive themselves to be working in other fields. To indicate this distinction, we introduce a subscript for the individual's perception. Thus, a D_oOS is a Ph.D.-holding scientist working in oceanography who calls himself an oceanographer, whereas a D_aOS calls himself a biologist, chemist, physicist, or some other alternate field.

The classes of interest are designated symbolically by

$$TD_PES$$

where T indicates field of training, E indicates field of employment, and P indicates the field of employment as perceived by the individual. T, E, and P are designated specifically, either as O indicating oceanography or A indicating an alternate field. An omitted symbol means field unspecified, and this is inclusive of both O and A. The classes of doctoral scientists discussed in this study and the relationships between them are the following:

DS-----------------------Doctoral Scientists,
DSO----------------------Doctoral Scientists in Oceanography,
ODS--Oceanography-Trained Doctoral Scientists,
DOS----------------------Doctoral Oceanography-Employed Scientists,

ODOS--Oceanography-Trained, Doctoral Oceanography-Employed Scientists,
ODAS--Oceanography-Trained, Doctoral Alternately Employed Scientists,
ADOS--Alternately Trained, Doctoral Oceanography-Employed Scientists,
AD$_o$OS-ADOS who perceive of themselves as working oceanographers,
AD$_a$OS-ADOS who do not perceive of themselves as working oceanographers, and
D$_o$OS-all DOS who perceive themselves as working oceanographers.

It follows that

ODS = ODOS + ODAS,
DOS = ODOS + ADOS,
ADOS = AD$_o$OS + AD$_a$OS,
D$_o$OS = ODOS + AD$_o$OS.

C. PRIMARY DATA

As examples of important data and of data quality we show first a comparison of the Annual Census (AC) and Biennial Survey (BS) production rates for oceanography-trained doctoral scientists (Figure 8) and the confidence limits on the BS data on the production of doctoral oceanography employed scientists (Figure 9). The general trends of the AC and BS data for ODS production agree, but large fluctuations occur in the BS data. The mid-1970's decrease in production of both the ODS (Figure 8) and the DOS (Figure 9) in the BS data is not regarded as a real effect.

The Biennial Survey is our only data source that contains information about both training and employment. In order to utilize this information, which does involve breakouts within the oceanography subdisciplines, we have selected the production rate ratios displayed on Figures 10 and 11. Each figure depicts subclass ratios from the surveys (1973, 1975, 1977) averaged over several-year cohorts. From Figure 10 we conclude, for the purpose of developing the "Standard" Population, that the fraction of Oceanography-Trained Doctoral Scientists who enter ocean science as an occupation (the ODOS:ODS production rate ratio) is, and has always been, about 70 percent. In the BS data, Alternately Trained Doctoral Scientists who work in oceanography are self-identified (AD$_o$OS). The ratios for alternately trained to oceanography-trained oceanographers AD$_o$OS:ODOS in the data summarized in Figure 11 indicate a trend, changing from considerably larger than 1 to 1 for persons entering oceanography prior to 1965 to slightly less than 1 to 1 recently. In spite of this change, the proportion of ADOS to ODOS in the total population remains about 2 to 1.

The production rate of Doctoral Oceanography-Employed Scientists (DOS) from the *Modified Directory of Marine Scientists Data* (DMS) is presented in Figure 12 and compared with the training rate of Oceanography-Trained Doctoral Scientists (ODS) from the Annual Census (AC). The DOS rate as given by the DMS prior to 1973 and the ODS rate from the AC are the most reliable quantitative information available to us. Because year-to-year fluctuations in the relatively small rates of production of oceanographers are not considered significant, Figure 12 also depicts the data smoothed by a running three-year average. We interpret Figure 12 as indicating that the survey method for obtaining the *Directory* data (sending the questionnaires to selected administrators at the institutions included) was not effective in counting recent DOS, and we do not believe the indicated post-1972 decrease. Note that by 1974 the DMS-ODS rate crosses a good estimate of ODOS obtained by multiplying the AC-ODS rate by the BS-ODOS:ODS rate ratio of 70 percent. Already by 1973 the DMS-DOS rate falls past the $\mathrm{D_{o}OS}$ rate estimate obtained by supplementing the ODOS estimate by 75 percent as indicated by the BS (Figure 11). Recall that DOS = ADOS + ODOS = $\mathrm{AD_{a}OS}$ + $\mathrm{AD_{o}OS}$ + ODOS and so forth.

Figure 13 and 14 show percentage distribution for the employment sector and work activity for three Biennial Surveys and for the data derived from the *Directory* before the data were supplemented by adding an estimate for the industrial sector. The missing industrial component is evident explicitly on Figure 13 and implicitly in the high teaching percentage for the *Directory* on Figure 14. The research category in Figure 14 (and elsewhere in this report) includes field work that, because of the nature of the work, might be considered as "surveys" or "operations." These and similar data provide the estimates for the distributions shown on Figures 5 and 6.

D. MODEL FOR THE "STANDARD" POPULATION

The "Standard" Population (SP) Model for classes of doctoral scientists in oceanography is based on the smoothed (running three-year average) Oceanography-Trained Doctoral Scientists (ODS) AC data and the Doctoral Oceanography-Employed Scientists (DOS) DMS data prior to 1973 (Figure 12) and the Biennial Survey class ratios (Figures 10 and 11). To obtain the 1973-1978 "Standard" Population DOS production rates, the DMS-DOS production rate curve was simply extrapolated forward from 1972 at a rate of five more DOS per year as shown on Figure 15. For the purposes of this study, the dates of receipt of Ph.D. reported in the BS and DMS data for scientists in 1973, 1975, 1977 and 1974, 1977, respectively, are assumed to provide production rates. If, alternatively, a constant rate of 135 per year were assumed for this period, the "Total" Population growth curves would be little affected. The "Standard" Population Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS) production rate is taken to be 0.7 times the ODS production rate. The production rate of "Standard" Population Alternately Trained Oceanography-Employed Scientists who perceive themselves to be oceanographers ($\mathrm{AD_{o}OS}$) is obtained from the ODOS rate by adopting from the $\mathrm{AD_{o}OS}$:ODOS rates ratio values of 200 percent for the 1958-1965 interval and 75 percent for the 1966-1978 interval. These model "Standard" Population production rates are shown on Figure 15. This model is consistent with the data available from the three sources utilized; compare e.g., the rate of the model Doctoral Oceanography-Employed Scientists who perceive themselves to be oceangraphers ($\mathrm{D_{o}OS}$) curve (b) Figure 15 with the BS-$\mathrm{D_{o}OS}$ rate (Figure 9).

Recall that the Biennial Survey does not provide a total DOS estimate, and note the "Standard" Population AD_aOS estimate as given by the difference between curves (a) and (b) on Figure 15. All the remaining "Standard" Population production rates (see Figures 1 and 3) are obtained from the rates on Figure 15 by using the definitions in Section B above. The "Standard" Population growth curves (Figures 2 and 4) were then obtained by integration of the rate curves.

E. THE "TOTAL" POPULATION

Estimates for the "Total" Population of classes of doctoral scientists in oceanography are presented in Table 1 for 1978. The post-1958 cohort estimates are from the "Standard" Population integrals. The pre-1958 Doctoral Oceanography-Employed Scientists (DOS) number is from the DMS. Figure 11 indicates a pre-1958 AD_oOS:ODOS ratio of 4.5 to 1. From an extrapolation prior to 1958 of the "Standard" Population-ODOS: DOS rate ratios implied by Figure 15, a value of 7 percent was adopted. All the estimates of Table 1 are obtainable from these assumptions and definitions. The important and reliable fact about the pre-1958 population is simply the DMS-DOS number of approximately 400, of whom all but a very few were alternately trained.

F. SCIENTIFIC SUBFIELDS

Although we have defined and discussed classes of "doctoral oceanographers," as noted in the Introduction, the term "oceanographer" encompasses a broad range of scientific activity. The questions of interest that this study bears upon, such as the match or mismatch between production rates and needs for doctoral scientists and the desirability of direct training versus entry into ocean science by field-switching basic-science doctoral scientists, could well have different answers for the different scientific subfields if the facts were known. It is more difficult and less accurate to analyze the subfield population numbers because they not only are smaller but require further inferences from the primary data. The credibility of the "Standard" Population's subfield model presented in this section is less than that of the overall model because additional assumptions are involved.

For Doctoral Oceanography-Employed Scientists (DOS) an accurate subfield breakout is available in the *Directory* data. Figures 16 and 17 present both the *Directory*-DOS subfield numbers and percentages. The problem here is again the lack of usable data beyond 1973. Subfield information on Oceanography-Trained Doctoral Scientists (ODS) is not available from the Biennial Survey and unfortunately only indirectly and incompletely from the Annual Census. Subfields were assigned to AC-Oceanography-Trained Doctoral Scientists (ODS) who had recorded bachelors or masters degrees of identifiable specialty. The resulting rates of production by identifiable subfields are shown on Figure 18, which also shows the rate of production of AC-ODS of unknown subfield. For example, the unknown rate in 1974 amounted to 35 percent of the total.

Production rates and growth curves for subfields in the "Standard" Population are presented in Figures 19 through 22. The model for

"Standard" Population (SP) DOS subfields was obtained by applying subfield percentages to the extrapolated total SP-DOS population in the period 1973-1978 fixed at their average values during the early 1970's. The values adopted were (Figure 17) biological, 50 percent; physical, 22 percent; geological/geophysical, 19 percent; and chemical, 9 percent. For the ODS, the number with unknown subfields was distributed among the subfields each year in the same percentages that occurred in the identified subfield rates that year.

The rate of production of biological (including fisheries oceanography DOS) has been dominant over the entire 1958-1978 period (Figure 19), with the result that the population number is now estimated at half of the total DOS (Figure 20). Geological and physical population numbers are approximately equal, with the geological rate peaking and leveling off in the mid-1960's, about half a decade ahead of the physical rate. The approximately equal production of chemical and geological/geophysical oceanography Ph.D.'s (see Figure 21) may be surprising to those mostly familiar with the programs of the major institutions. To test the credibility of this finding, data were obtained from each of the top 10 producers of oceanography Ph.D. holders in 1977 on the number of Ph.D. degrees granted during 1977-1979 and the number of doctoral candidates expecting to graduate during 1980-1982 with biological, physical, chemical, or geological/geophysical oceanography degrees. The 8 with research programs relating to deep-water open oceans had produced 35 chemistry Ph.D.'s and 72 geology/geophysics Ph.D.'s; the two remaining had produced 9 chemistry Ph.D.'s but no geology/geophysics Ph.D.'s. Because there are many more institutions in the latter category; we believe that the data are credible. See Appendix A for more details.

The biological ODS production rate in the "Standard" Population (Figure 21) is also the largest in 1978. This is due to a marked increase in the early 1970[illegible] Geological ODS production dominated the 1960's. The physical production rate is recently increasing as rapidly as the biological, while [illegible] chemical production rate shows a slow steady increase, which, in the 1978 "Standard" Population, equals the geological rate. The "Standard" subfield population numbers (Figure 22) reflect this pattern of rate changes. Only in 1977 did the biological population number pass the geological. The "Total" Population number for the SP-ODS subfields (Figure 22) cluster much more closely than do the corresponding SP-DOS numbers (Figure 20). This is evident in the 1978 scientific subfield percentage distribution shown earlier on Figures 5 and 6.

G. FIELD MOBILITY

Oceanography was originally populated at the doctoral level by scientists trained in the basic disciplines, and a continued flow of Alternately Trained Doctoral Oceanography-Employed Scientists (ADOS) into ocean science is generally regarded as beneficial to the field. Also, we have seen that a substantial fraction (30 percent) of scientists who receive Ph.D. degrees in oceanography work elsewhere. A knowledge of the origin of Alternately Trained Doctoral Oceanography-

Employed Scientists (ADOS) and the work activity of Oceanography-Trained Doctoral Alternately Employed Scientists (ODAS) is interesting and relevant to points of educational policy. Should fewer ODS be produced in order to maintain a healthy flow of ADOS into the field? Should the number of ODS produced be well in excess of estimated need for ODOS since the flux into ODAS at the postdoctoral level is easy or desirable?

The NRC Biennial Surveys (BS) deal with doctorates in all fields of science and engineering. The BS includes data on the transition from field of training for the doctorate to the field of employment. Table 2 displays the subfield information available from the 1977 BS on the educational background of AD$_{O}$OS and the employment of ODAS. Although the estimates in Table 2 are relatively imprecise and inferred from much smaller samples (see Appendix A), a clear qualitative picture emerges. About half of the ADOS originate from the life sciences, with the remainder coming almost equally from the physical sciences and other earth sciences. On the other hand, the other earth sciences and life sciences together and equally account almost totally for the ODAS.

4. THE EDUCATION OF DOCTORAL SCIENTISTS

This chapter discusses the institutional origin of classes of doctoral scientists in oceanography and the concept of a doctoral degree in oceanography.

A. OCEANOGRAPHY-TRAINED DOCTORAL SCIENTISTS

The large increase in the number of institutions producing Oceanography-Trained Doctoral Scientists (ODS) has been illustrated in Figure 7. The Annual Census is the data source for Figure 7 and for Table 3, which tabulates the number of ODS produced by 51 institutions that granted Ph.D. degrees recorded in the Annual Census as oceanography in the perception of the recipient in the period 1958-1977. The largest number of institutions granting degrees in any of the three-year intervals of Figure 7 is 39 for 1975-1977, less than the total number of 51 of Table 3 because not all of the institutions who granted degrees in the earlier period did so during that interval.

In order to illustrate the role of major institutions in training ODS, two pie diagrams are presented that include a sector for all institutions granting 3 percent or more of the total degrees awarded in the 1958-1977 interval (Figure 23) and in 1977 (Figure 24). Year-to-year variability in output of Ph.D.'s will change the ranking order. The top producers in 1976, 1977, and 1978 were the University of Rhode Island with 12, Oregon State University with 15, and the University of California at San Diego, with 23, respectively. Ten institutions accounted for 80 percent of the degrees awarded during 1958-1976 and 10 for 82 percent of the degrees awarded in 1977. Eight major institutions are common to both diagrams: University of California at San Diego, Oregon State University, Texas A&M, University of Rhode Island, University of Washington, Massachusetts Institute of of Technology/Woods Hole Oceanographic Institution, University of Miami, and Florida State University. In addition, Johns Hopkins and New York University appear on the 1958-1976 diagram but are replaced by the University of Hawaii and William and Mary on the 1977 diagram.

B. DOCTORAL OCEANOGRAPHY-EMPLOYED SCIENTISTS

The institutional origin of working oceanographers differs considerably from the Oceanography-Trained Doctoral Scientists (ODS) picture. Recall that only 70 percent of ODS become ODOS and that 70 percent of DOS are ADOS and not directly trained in oceanography. Figure 25 is a pie diagram similar to Figure 23 but for DOS originating from the most productive institutions during the interval 1958-1976. The data source for Figure 25 is the *Directory*, which is inclusive only prior to 1973.

The educational background of the DOS is much more diverse than for the ODS. The nine United States institutions that produced 3 percent or more DOS account for only 36 percent of the total. Of these nine, six (University of California at San Diego, Oregon State University, Texas A&M, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution, University of Washington, and University of Miami) are also major ODS producers in the 1968-1976 interval and three (Columbia, Harvard, and Stanford) are not. Of the remaining 64 percent, 8 percent were produced by foreign universities and 56 percent by 140 other U.S. institutions.

C. THE Ph.D. DEGREE IN OCEANOGRAPHY

The concept of a doctorate in the field of oceanography requires clarification and definition if educational policy in ocean sciences is to be afforded a common basis for interinstitutional discussion. In Chapter 2 we mentioned several factors that bear on the determination of the field of the degree, including the titles of the degree itself and of the department, program, and institution granting the degree; the stated curriculum requirements for the Ph.D.; and the program of the individual doctoral student. It is not the intention of this section to offer a comprehensive discussion but merely to present some relevant additional information.

At this time in the evolution of ocean science, the panel recommends that the substantial content of the Ph.D. program be the most important factor in determining whether a degree is an oceanography degree. Certainly such content should exceed the importance of the actual degree title. In the absence of clearly defined and generally accepted criteria (e.g., Engineering Society accreditation procedures), subjective judgments play a role. Perceptions of educators, scientists, and recent doctorates recipients are relevant. In fact, if we introduce an individual's perception factor for training analogous to that used previously for employment, we would label all the ODS considered so far in this study as O_ODS, because we have used information from the Annual Census and the Biennial Survey in which individuals check a box indicating the field of their Ph.D.

Table 5 compares Annual Census Oceanography-Trained Doctoral Scientists (Column I) institutional origin data with *Directory* Doctoral Oceanography-Employed Scientists institutional origin data for 12 institutions selected for special study. The totals of these columns satisfy the "Standard" Population model relationships (0.7 ODS = ODOS and ODOS/DOS = 0.3) very closely, but a glance at the individual institutional numbers reveals a wide range of behavior for this relationship. Not surprisingly, individuals from the various institutions regard their degrees differently. To a large extent, this depends on whether the individual trained in oceanography continues to work in oceanography or another field. The main point of Table 5, however, is in Columns II and III, which exhibit individual institutional administrator's sorting of *Directory*-DOS into the ODOS and ADOS categories. The *Directory* listings of each institution's scientists (Column IV) were sent by the panel to institutional officers for this purpose. The simple notation ODOS and ADOS is retained for the categories sorted in this way since it represents establishment rather than individual perception. Again, results differ according to the type of institution. At the University of California at San Diego, students and administrators clearly agree that the degree is in oceanography and virtually all ODS become ODOS. At Massachusetts Institute of Technology/ Woods Hole Oceanographic Institution, the University of Washington, and the University of Miami, many students whose institution otherwise designates the degree believe that they have received an oceanographic doctorate. A substantial number of holders of doctoral degrees from the University of California at Berkeley, Harvard, and Stanford work in oceanography. The Berkeley and Stanford students and educators agree that their degrees are in the basic disciplines, but about half of the Harvard degrees are substantially oceanographic.

The degrees available in U.S. institutions of higher learning in ocean science and directly related fields are listed by type and title in Table 6. This tabulation was prepared from material in the government-sponsored *University Curricula in the Marine Sciences* 1975-1977 and the American Meteorological Society's *Curricula in the Atmospheric and Oceanographic Sciences* 1976 (see Appendix A). Between 100 and 150 variously labeled doctoral program options are now available for prospective students interested in becoming an oceanography-trained doctoral scientist. Unfortunately, for the unitiated prospective student and the conscientious but nonspecialist college guidance counselor, the programs reported are highly variable and extremely difficult to compare.

5. DEMOGRAPHY

This chapter presents social profiles and demographic characteristics and compares doctorates in the "fine" field of oceanography with doctorates in other major fields such as physics, chemistry, and the life sciences. It will be seen that ocean scientists do not differ substantially from their colleagues in other scientific fields. They do show somewhat greater mobility between fields, they enter their graduate program from a wider range of baccalaureate backgrounds, and their average age is less than the average age of all scientists. Their pay is somewhat lower, probably because of their lower average age. Although there is still a small proportion of women among oceanography graduates, their numbers are increasing. The proportion of caucasians is high compared with other fields. Only engineering has fewer minority members than the ocean sciences.

While considering the comparisons with other fields, it is important to remember that we are comparing a small, "fine" field (and frequently estimates based on a small sample of that field) with large, major fields. Appendix A presents a discussion of the sampling problem. In some cases, particularly for the Biennial Survey data, the data reported are based on a small sample of the small field of oceanography. Thus caution is urged in interpreting the data.

A. SEX, RACE, CITIZENSHIP, AGE, AND TIME FOR DEGREE

The oceanographic doctoral population is strongly male dominated (Table 7). However, the percentage of women receiving ocean science doctorates has increased in the past decade. Between 1968 and 1978, women earned about 6 percent of oceanography doctorates, and by 1975-1978 about 10 percent of the oceanography Ph.D.'s were being awarded to women (Figure 26). Because of the relatively small number of individuals and the concurrent large year-to-year variability, three-year running averages are used to illustrate this trend.

In common with most sciences, oceanography includes few racial or ethnic minorities. Among U.S. citizens and noncitizens on permanent visas who earned Ph.D. degrees in oceanography in the United States in 1973-1976 and whose ethnic origins were known, only 6 percent were minorities. Further, most (65 percent) of this minority group were Asian. Asians also dominate the group of minority doctoral oceanography-employed scientists. In 1977, only Asians constituted a significant percentage (4 percent) of the total (Table 8).

A substantial number of doctorates in oceanography have been awarded to foreign citizens. In the early 1960's the percentage fluctuated widely each year, probably because of the relatively small number of degrees awarded. During the period 1958-1978, about 8 percent of all oceanography doctorates were awarded to nonimmigrant foreign citizens. There is no clear trend, although the proportion appears to be rising slightly over the past few years (Figure 27).

As is seen in the previous chapter, ocean scientists as a group are younger than scientists in other fields. More than 75 percent of the oceanography-trained doctoral scientists practicing in 1977 obtained their degrees between 1965 and 1974, a much higher proportion than is evident for any other field (Table 7). This is particularly true for the years between 1970 and 1974.

The median age at which the 1977 doctorates were awarded was 31 (Figure 28). This involved a total time of eight years between the baccalaureate and receipt of the higher degree (Figure 29). The oceanography doctorate holders do not differ significantly in this respect from those in other major science fields.

B. RECRUITMENT, GROWTH RATE, MOBILITY, AND EMPLOYMENT

One unusual characteristic of ocean scientists relative to other scien-sts is the small percentage of ocean scientists with the baccalaureate degree in the same field as the Ph.D. Until recently, there were few schools offering such a degree and most ocean scientists considered a bachelor's degree in a major scientific discipline as the appropriate preparation for graduate study in oceanography. A profile of 1977 oceanography Ph.D. recipients (Appendix Table B.2) shows only about 4 percent with oceanography baccalaureates, compared with about 60 percent among all scientists. In the case of master's degrees, on the other hand, oceanography is similar to the other sciences. About 76 percent of ocean scientists who have a masters and a doctorate have those degrees in the same fields (Appendix Table B.2). The strongest recruitment into oceanography from other predoctoral degrees is from earth sciences and biology, although a substantial percentage transfer from physics. (Recall also Chapter 4, Figure 18.)

Between 1973 and 1977, the rate of increase (46 percent) in the number of Doctoral Oceanography-Employed Scientists (DOS) estimated by the Biennial Survey was greater than in all major fields (27 percent; Appendix Tables B.21 and B.24). By 1978 the "Total" Population was comparable in size with those in other fields such as meteorology and astronomy. Most DOS's were employed full time. The proportion of new graduates undertaking postdoctoral positions was high compared with those in other fields except for life sciences.

One of the most striking differences between the ocean sciences and other fields is the relatively easy mobility between fields. In spite of the greater specificity of training in the basic sciences, oceanography-trained scientists move smoothly into the other science fields.

As is apparent from the figures in the previous chapter, oceanography is one of the few fields that has been successfully entered by large numbers of scientists at the doctoral level who had no previous training in oceanography, particularly in earlier years. In 1977, the proportion of ocean scientists employed in the same field as the field of the doctorate was smaller than for most other science fields, with movement into the other earth sciences and biology especially strong (see Table 2, Chapter 2, as well as Appendix Tables B.25, B.26, and B.27). However, the proportion of doctoral scientists in oceanography who are employed outside of science also is considerably less than for any other field (Table 9 and Figure 30).

Most oceanography doctorate holders are in the labor force, and few are unemployed and seeking work. The proportion who are not employed at all also is lower among oceanography Ph.D.'s than in other fields, again in part reflecting their younger age, since this nonemployed group includes both persons seeking work and retired scientists (Table 9). The proportion of new oceanography Ph.D.'s still seeking employment at the time the degree is awarded has increased somewhat in recent years (Figure 31), along with a significant increase in the trend toward postdoctoral appointment (see Appendix Table B.9 and Figure 31).

C. EMPLOYER, ACTIVITY, GEOGRAPHIC LOCATION, AND SALARIES

A difference between ocean scientists and other scientists and engineers also is evident with respect to the type of employer (Appendix Table B.17). Academia is the top employer of oceanographers, as is the case for all other fields except engineering, but these doctoral ocean scientists are primarily engaged in research. The second largest employer of ocean scientists is government, and industry is third. Among all doctoral scientists, industry ranks second and government third.

There is a difference in the type of work undertaken as the primary activity of ocean scientists when compared with the major fields. A higher percentage are engaged in research and development (52 percent) than in any of the major fields. The average for all fields is 34 percent (Appendix Table B.10).

The proportion of oceanographers employed principally in teaching decreased somewhat between 1973 and 1977, while the proportion performing research increased. This trend is reflected also in the data for other fields. In absolute numbers, however, oceanographers are considerably less likely than other scientists to be employed principally in teaching (17 percent compared with 31 percent) and more likely to be involved in research (52 percent compared with 34 percent) (see Appendix Table B.19).

About half of the practicing oceanographers within the United States were employed on the eastern seaboard in 1977, including one fourth in New England; a third were on the Pacific Coast; and less than a tenth on the Gulf Coast. About 5 percent were employed around the Great Lakes (Figure 32).

The average salaries of oceanographers are less than the average for most major science fields. This is probably because the majority of its practitioners are younger than the average of all scientists (Table 10). However, comparison between 1973, 1975, and 1977 data suggests upward relative change as the age levels also move slightly upward. Additionally, the increasing involvement of ocean scientists in industry probably has improved the general salary picture in the past two years.

6. DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

A. THE ROLE OF ALTERNATELY TRAINED DOCTORATES

Alternately Trained Doctoral Scientists dominate the field of working oceanographers holding a Ph.D. by more than 2 to 1. It is the panel's opinion that the vitality of ocean science is best served by maintaining a substantial flow of such scientists into the field. Therefore, the panel wishes to alert the oceanographic community to a significant change in this regard. A major finding of the present study is the leveling off of the entrance rate of alternately trained doctoral scientists in the 1970's and the matching of this rate at the end of the decade by the continually increasing rate of production of oceanography trained doctoral scientists. Thus the balance appears to be changing, and the influence of basically trained scientists in oceanography could be considerably lessened in the near future. Furthermore, the newly acquired corpus of oceanographic fundamentals mentioned above makes it increasingly difficult and time consuming for alternately trained doctoral scientists to enter the field and to compete initially with oceanography-trained rivals. Although the problem is probably not yet urgent, it is important to recognize that positive action to maintain a healthy flow of alternately trained doctoral scientists into the field may require such actions as recruitment, training programs, and the allocation of funds for postdoctoral conversion.

B. THE DIRECT TRAINING OF DOCTORATES IN CONTEMPORARY OCEAN SCIENCE

Oceanography-trained doctorates are becoming increasingly numerous and influential, and the number of such degree programs has proliferated although a few major institutions continue to dominate production.
There appears to be a healthy flexibility coupled with novelty and diversity and the lack of understanding of what, if any, general elements are desirable for types of Ph.D. programs. Moreover, the concept of an oceanographic Ph.D. degree itself requires both definition and clarification. For example, the perception of educator and degree recipient as to the field of degree frequently differ. Therefore, the panel *RECOMMENDS that the Ocean Sciences Board sponsor a curriculum study for the purpose of analyzing programs and contributing to the establishment of contemporary guidelines for doctoral degrees in ocean science.* Questions to be addressed should include: What is the nature

and range of material covered in existing programs? How well does the material relate to the fundamental scientific basis of oceanography, to the growing body of specialized knowledge, and to the essential multidisciplinary and interdisciplinary character of many increasingly important central problem areas? How well is the curriculum matched to the professional needs and the potential employment activities of the degree recipients? Are there curricula designed adequately to facilitate intrafield mobility and field switching and applications to environmental and other areas when desired? The panel further *Recommends that, generally and for the purposes of the recommended study, the definition of the Ph.D. degree in oceanography be based on the substance of the curriculum rather than the title of the degree itself or of the department that awards it.*

C. THE PROBLEM OF THE SUPPLY AND DEMAND

The present study concerns itself with the question of supply of doctoral scientists but not the demand. The determination of the present and growth characteristics of the population was a challenging and time-consuming task, and we believe the usefulness of our findings to be best served by timely publication. This report will, we hope, serve as a useful resource for individuals concerned with potential manpower needs in oceanography or the inclination or necessity for speculation or prediction. We do wish to observe, however, that our findings do not appear to imply at present a general overproduction of directly trained oceanographic doctoral scientists or a saturation or near saturation of the field by this class of doctoral scientist. This remark is based primarily on the alternately trained to oceanography-trained population number ratio and the relatively high degree of field mobility. Moreover, although ocean scientists relative to other scientists are employed predominately in academia, they are engaged there more in research than in teaching. The field appears healthy and to require a strong and diversified curriculum matched both to the evolving science itself and to demands associated with increased societal awareness of marine problems and affairs, as exemplified by the National Climate Program and the proposed Decade of the Oceans. The panel wishes to emphasize that these are general observations only and that the supply and demand situation can be expected to vary from subfield to subfield depending not only on factors arising from within the subdisciplines of ocean science but also from pressures originating in the much larger parent sciences, physics, biology, chemistry, and earth sciences.

In particular, the largest number of doctoral ocean scientists are involved in biological oceanography (including fisheries), and this number is increasing the most rapidly. This subfield was consequently the subject of special discussion by the panel. Although the proportion of biological oceanographers teaching is essentially the same as the proportion in other subfields, because about half of all oceanographers are biological oceanographers, the total teaching activity is greater in biological oceanography than in any subfield. Certainly there is a possibility that overproduction could result. However, at present, the data are not available to indicate that the production rate of biological oceanographers now exceeds the demand. Partly, this is due to the large number of environmental impact-related positions that are now available in response to recent legislation. Many biological oceanographers are employed in environmental assessment, either as field workers or as administrators. Perhaps this new area of employment could justify a shift in curricula for biological (and other) oceanographers to include courses in environmental assessment, impact statement writing, and program management. There is the danger, though, that the demand in this area is only temporary and that this employment market might not be so available in the future. At such time, the present production rate of biological oceanographers could be excessive.

D. INSTITUTIONAL ARRANGEMENTS AND RECORDS

Doctoral scientists are of central importance to any scientific field. Their research directs the evolution of the science itself, their teaching influences and molds the young practitioners, they are generally responsible for obtaining and managing resources, and they contribute to the communication of information and ideas to society at large. Virtually all of the employed oceanographers reported in the 1980 National Science Foundation report, *U.S. Scientists and Engineers 1978, Detailed Statistical Tables,* are doctorate holders compared with 20 percent of all scientists and 4 percent of all engineers. Thus the influence of the doctoral population in oceanography is relatively large when compared with that in the other major scientific fields.

Although this study has been limited to doctoral ocean scientists, we have also considered many general aspects of the scientific field. In doing so, a picture of contemporary ocean science in the United States has emerged. Although its history extends from the mid-1800's, ocean science is essentially newly established as a sophisticated and quantitative modern science comparable in size and some other aspects with meteorology and astronomy. Ocean science now has as its foundation a substantial body of fundamental knowledge, specialized techniques, and methodology. These fundamental elements, coupled with a rapid growth in numbers of practitioners, have led to the establishment of doctoral training programs in more than 50 institutions that now train half of the Ph.D.'s entering the field. Nonetheless, oceanography remains a diverse and complex science whose vitality is crucially supported by advances in the basic sciences on which it is founded. It is multidisciplinary and interdisciplinary and has no peer field for comparison purposes in this respect.

Because of rapid growth, recent maturity, and inherent heterogeneity, ocean science does not now have an institutional arrangement adequate and responsible for the oversight functions of record keeping and advocacy generally considered as necessary for scientific fields and, for most fields, provided for outside of the confines of the National Research Council. This issue emerged many times during the course of the panel's discussions, and a variety of options, including the status quo, were considered. On the other hand, several relevant professional societies exist that are necessarily concerned with various subfields of oceanography, indeed with some overlap of interests.

In the panel's opinion, what appears to be required is an organization, patterned in some respects after, for example, the American Institute of Biological Sciences or the American Institute of Physics, rather than after a professional society such as the American Meteorological Society. Whether this should be an individual membership society or structured from pre-existing associations and other fundamental considerations are questions recognized as well beyond the charge or concern of this panel. It is, however, the panel's deliberate opinion that a study to define a suitable organizational arrangement for oversight is urgently required--an "oversight institute" for U.S. ocean sciences. This organization should be responsible for the definition, advocacy, and monitoring of ocean science. It could serve as a forum for discussion of the contents and standards of educational curricula, keep records of manpower and of employment opportunities, and provide authoritative information on career possibilities to prospective oceanographers and on marine scientific issues of interest to the general public. Therefore, the panel *RECOMMENDS that the Ocean Sciences Board undertake such a study directed toward the possible establishment of an "oversight institute" for American ocean Sciences.*

In view of the size and importance of ocean science today, its rapid growth and evolution, the panel also *RECOMMENDS that reliable records be maintained and updated on a regular basis on the population characteristics and numbers of doctoral scientists in oceanography.* Until such a time as an oversight organization of the kind outlined above may be established or accept the responsibility, this activity should be carried out under the auspices of the NRC Ocean Sciences Board.

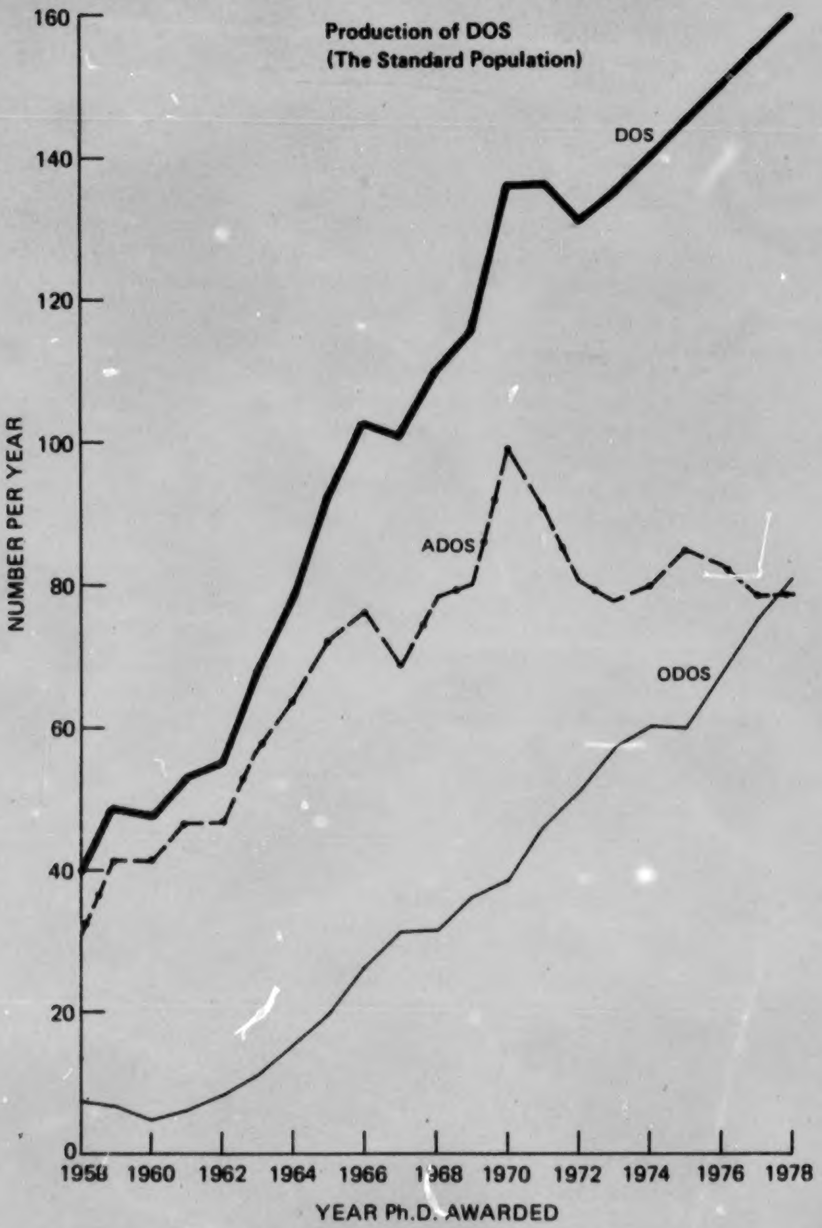

FIGURE 1 Production rates of Doctoral Oceanography-Employed Scientists (DOS), Alternately Trained Doctoral Oceanography-Employed Scientists (ADOS), and Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS), by year of doctorate in the "Standard" Population.

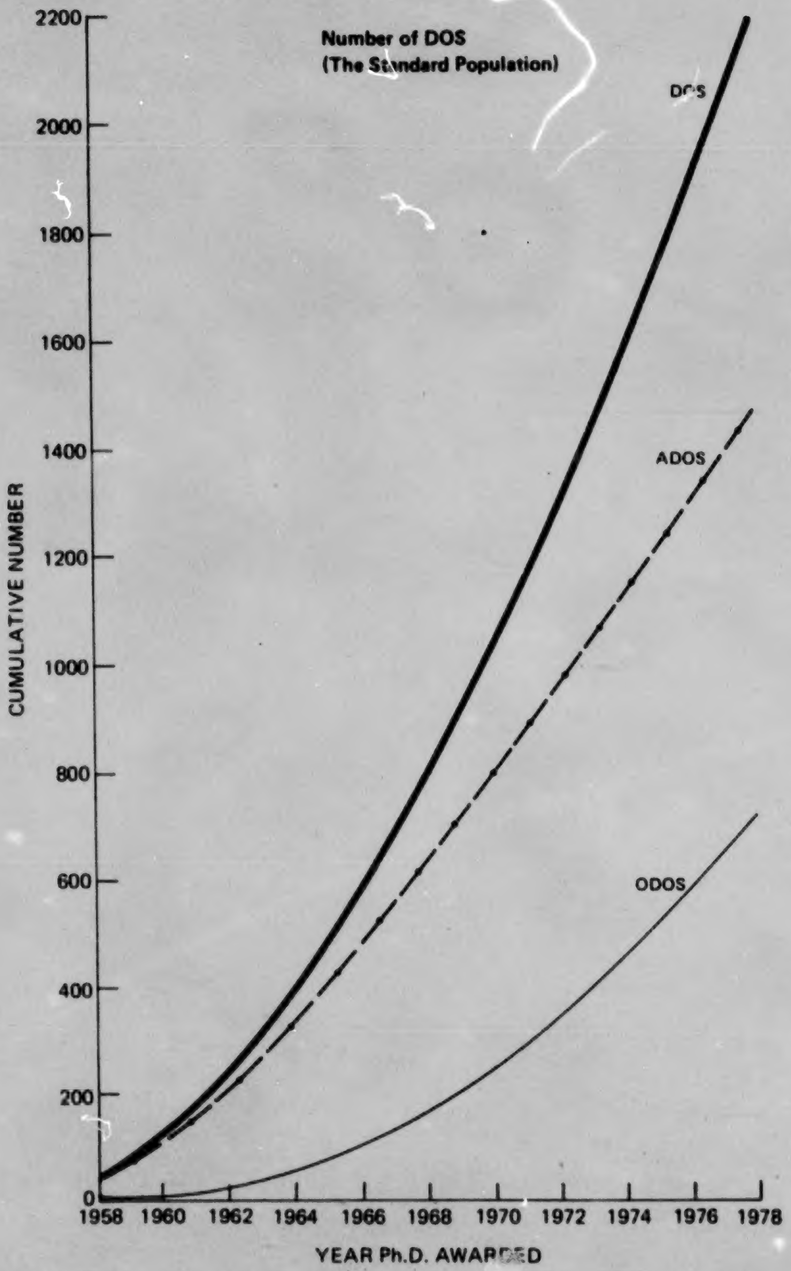

FIGURE 2 Population growth of Doctoral Oceanography-Employed Scientists (DOS), Alternate Trained Doctoral Oceanography-Employed Scientists (ADOS), and Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS), in the "Standard" Population.

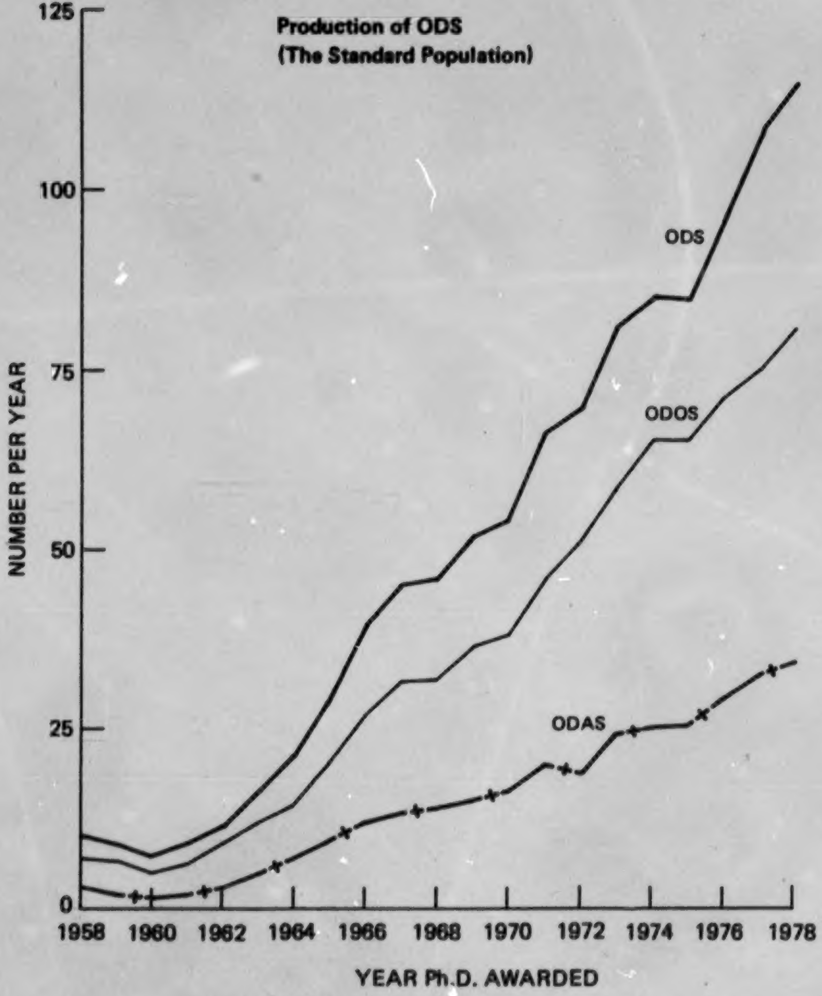

FIGURE 3 Production rates of Oceanography-Trained Doctoral Scientists (ODS), Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS), and Oceanography-Trained Doctoral Alternately Employed Scientists (ODAS), by year of doctorate in the "Standard" Population.

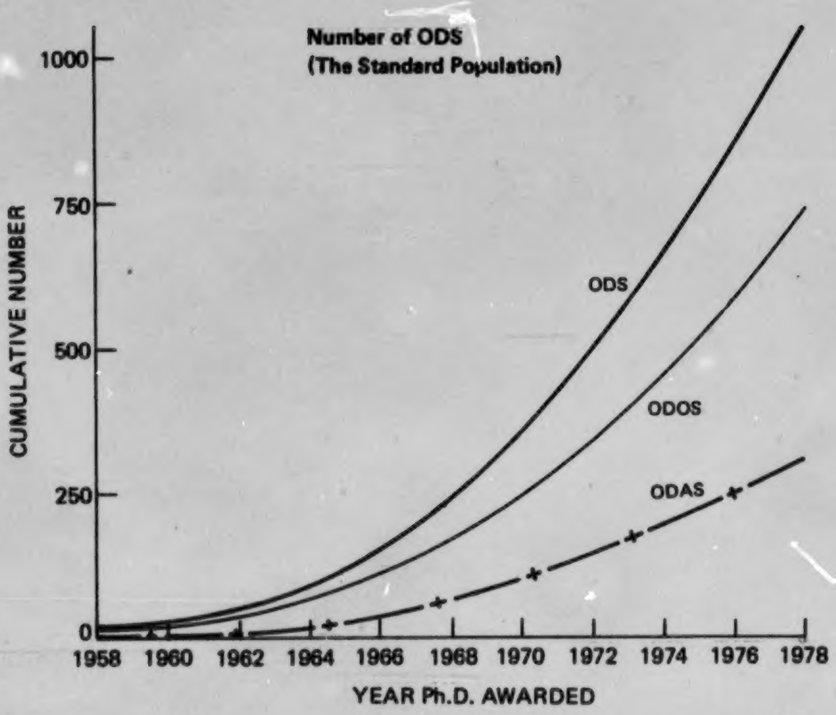

FIGURE 4 Population growth of Oceanography-Trained Doctoral Scientists (ODS), Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS), and Oceanography-Trained Doctoral Alternately Employed Scientists (ODAS), in the "Standard" Population.

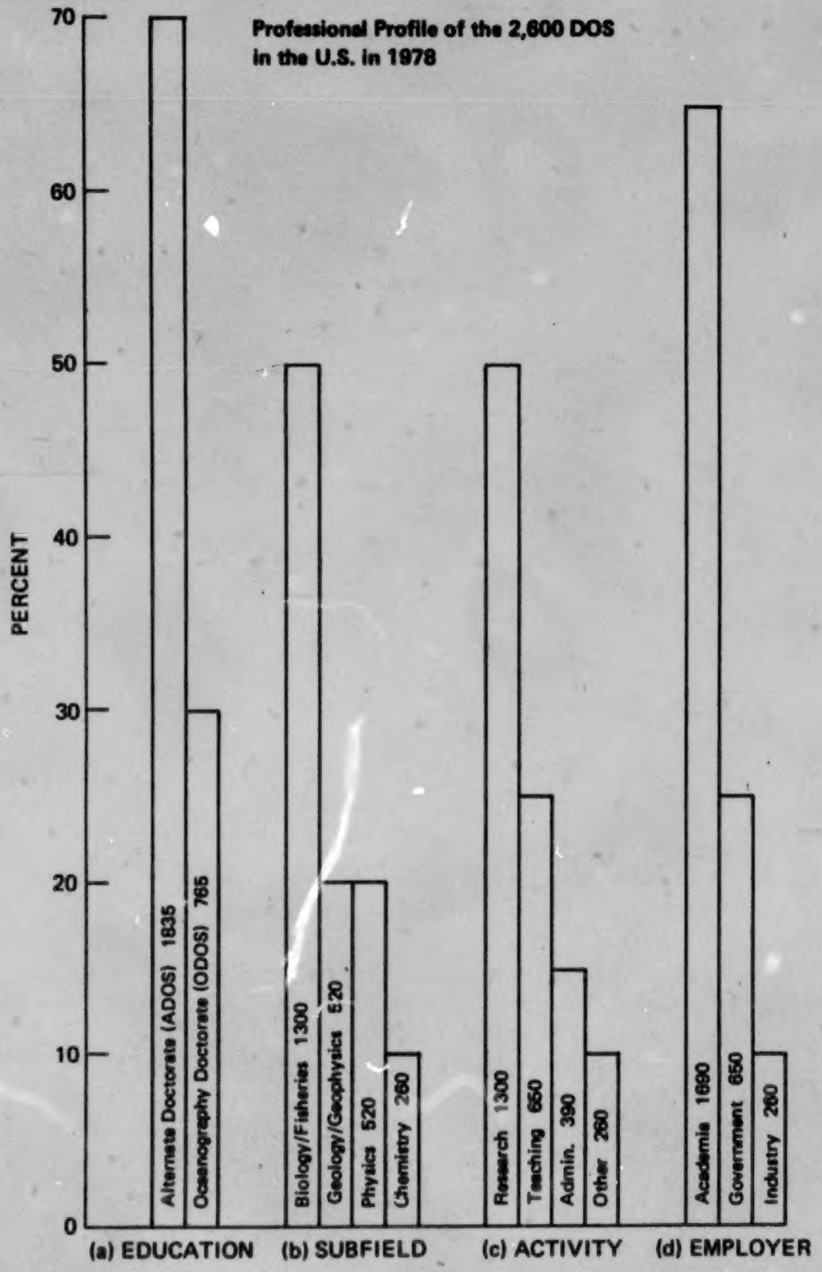

FIGURE 5 Education, subfield, activity, and employment characteristics of the present population of Doctoral Oceanography-Employed Scientists (DOS), in the "Standard" Population.

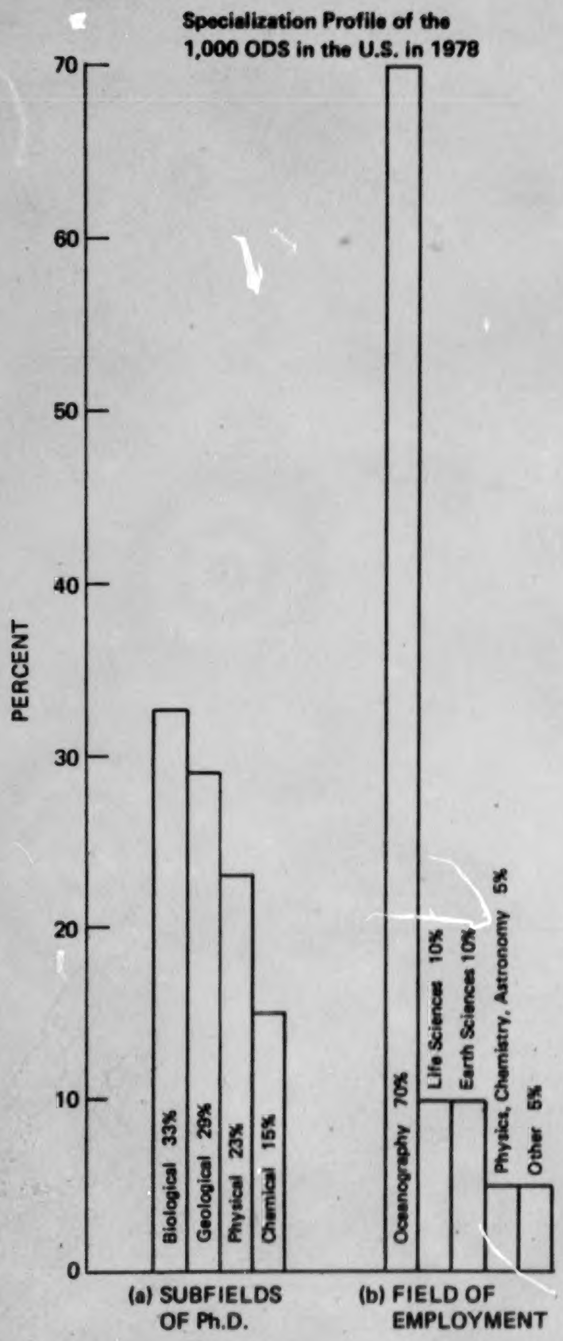

FIGURE 6 Subfield of doctorate and field of employment distribution within the present population of Oceanography-Trained Doctoral Scientists (ODS), in the "Standard" Population.

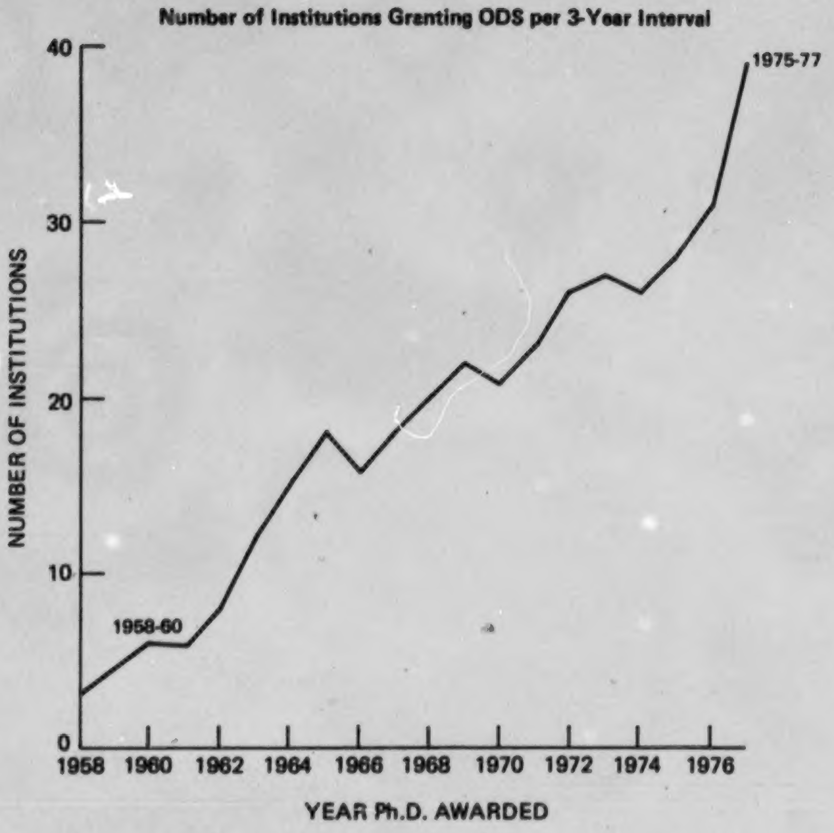

FIGURE 7 Number of institutions awarding Ph.D.'s to Oceanography-Trained Doctoral Scientists (ODS) in three-year intervals according to the Annual Census (AC).

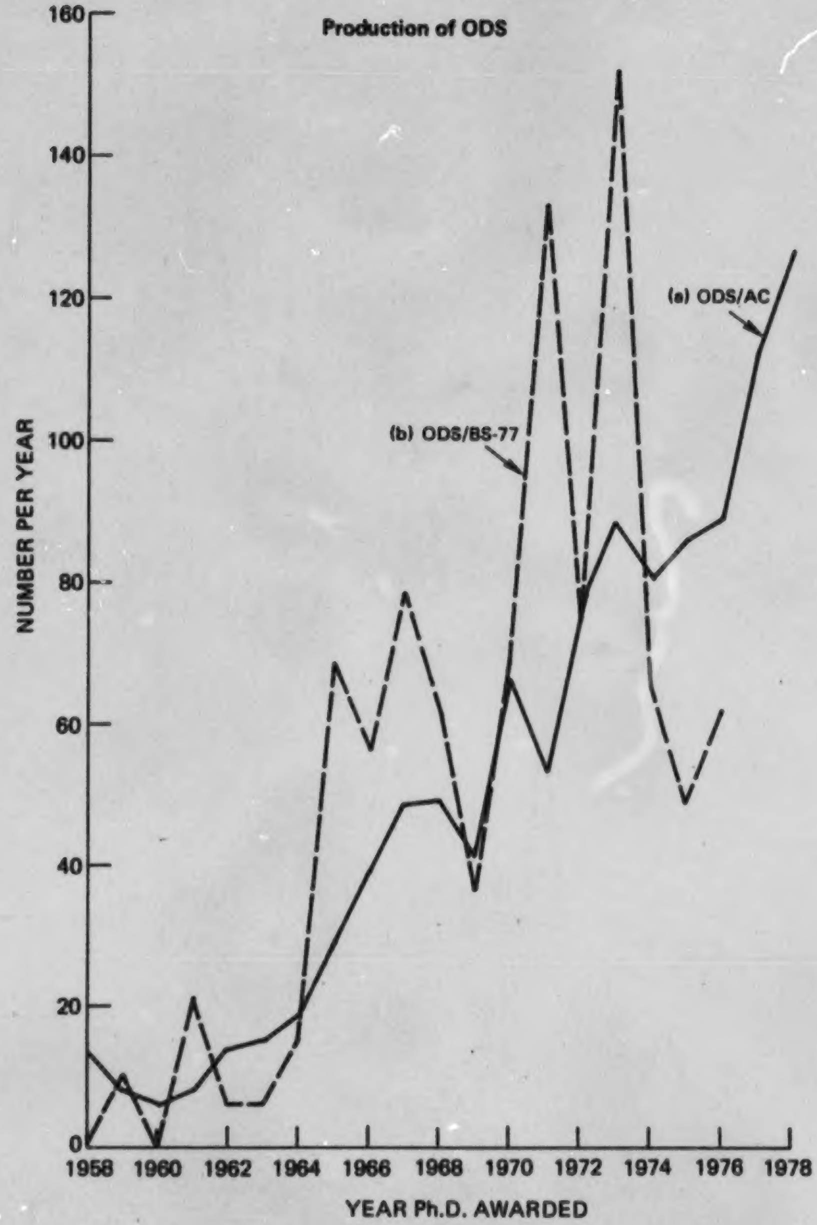

FIGURE 8 Production rate of Oceanography-Trained Doctoral Scientists (ODS) according to (a) Annual Census (AC), and (b) 1977 Biennial Survey (BS-77).

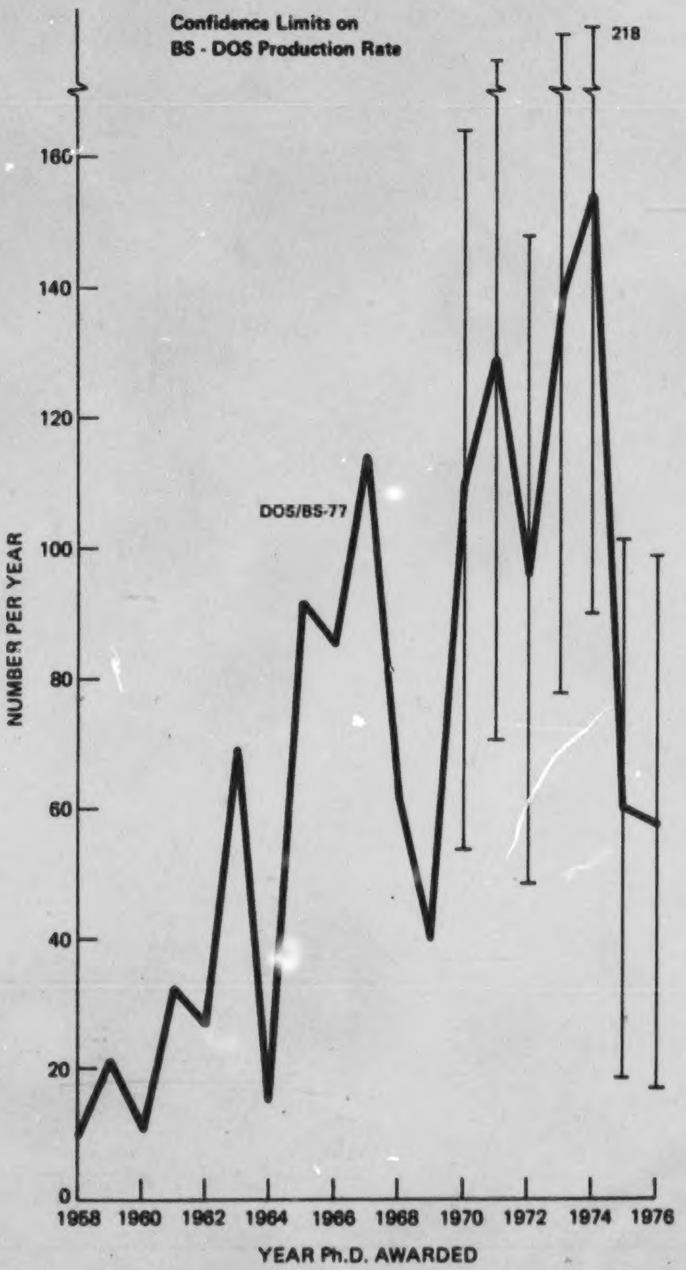

FIGURE 9 Confidence limits (95 percent) on date of receipt of Ph.D. of doctorate of Doctoral Oceanography-Employed Scientists (DOS) in 1977 according to the Biennial Survey (BS-77).

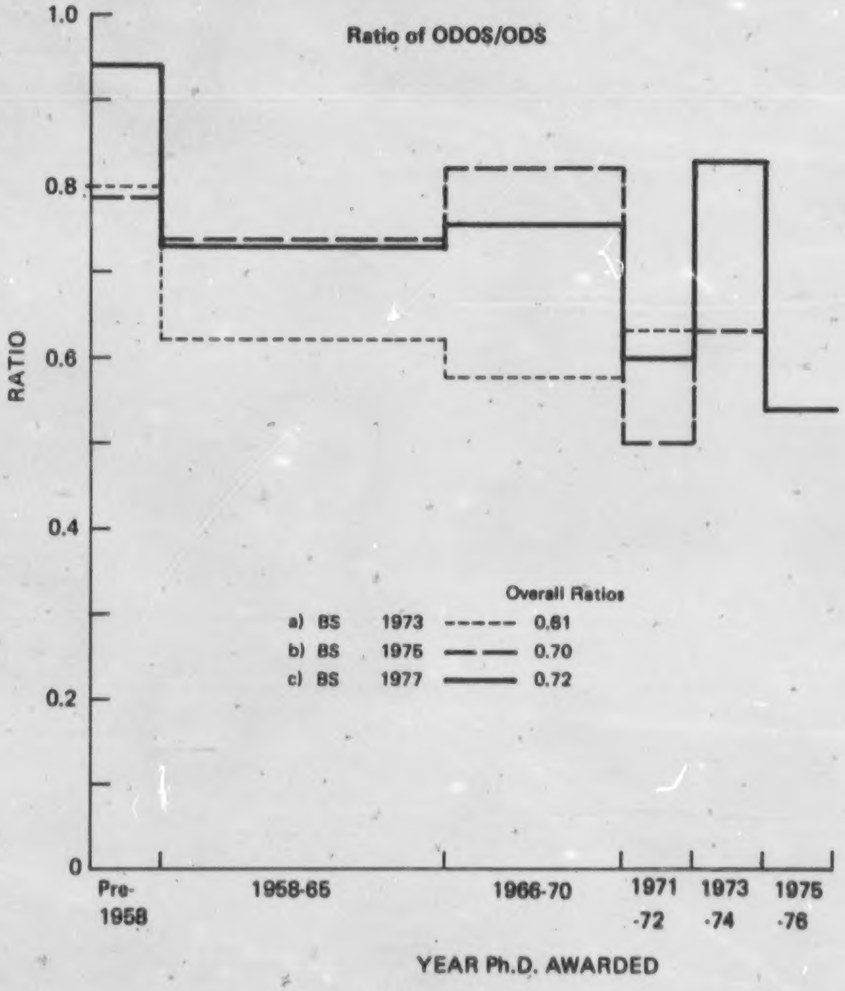

FIGURE 10 Ratio of Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS) to the total class of Oceanography-Trained Doctoral Scientists (ODS) in 1973, 1975, and 1977 by year of their Ph.D. according to the Biennial Surveys--(a) BS-73, (b) BS-75, and (c) BS-77.

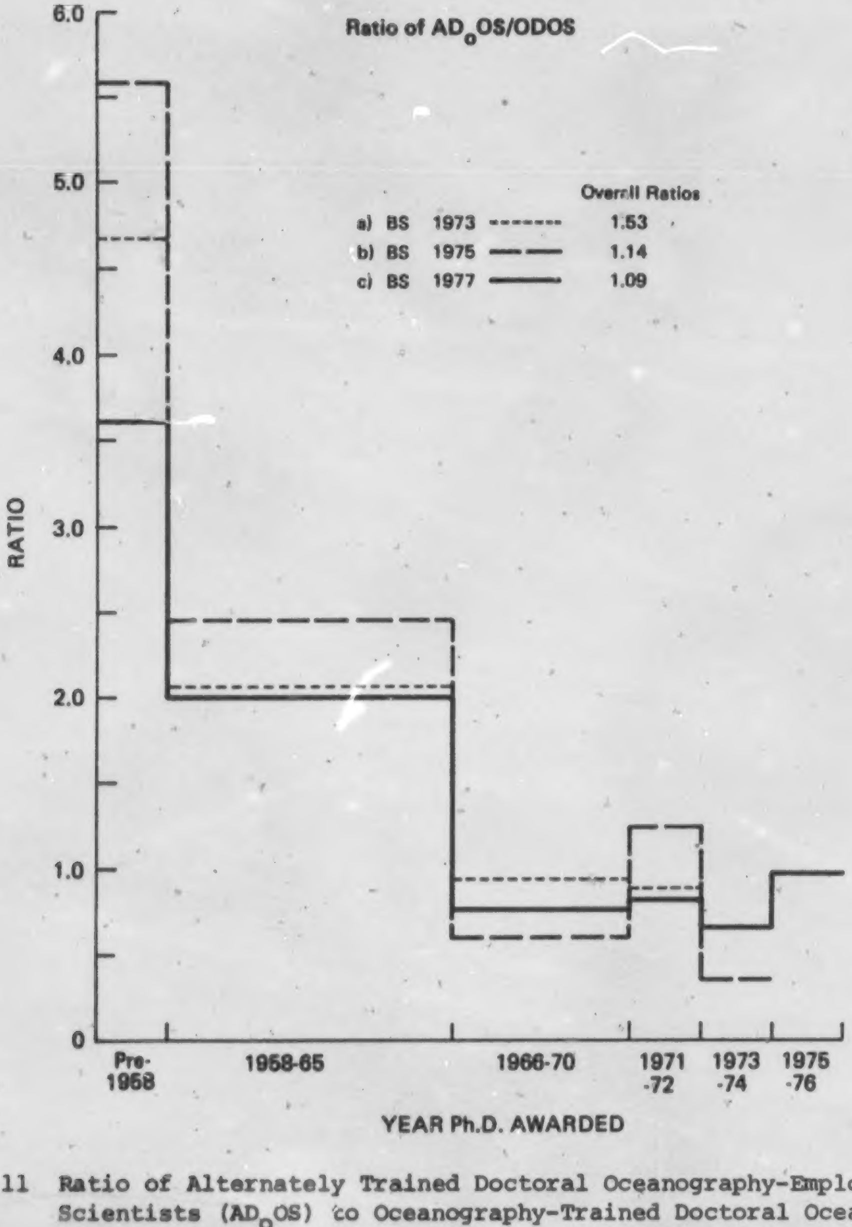

FIGURE 11 Ratio of Alternately Trained Doctoral Oceanography-Employed Scientists (AD_oOS) to Oceanography-Trained Doctoral Oceanography-Employed Scientists (ODOS) in the Class of Oceanography-Employed Doctoral Scientists who regard themselves as oceanographers (D_oOS) according to the Biennial Surveys--(a) BS-73, (b) BS-75, and (c) BS-77.

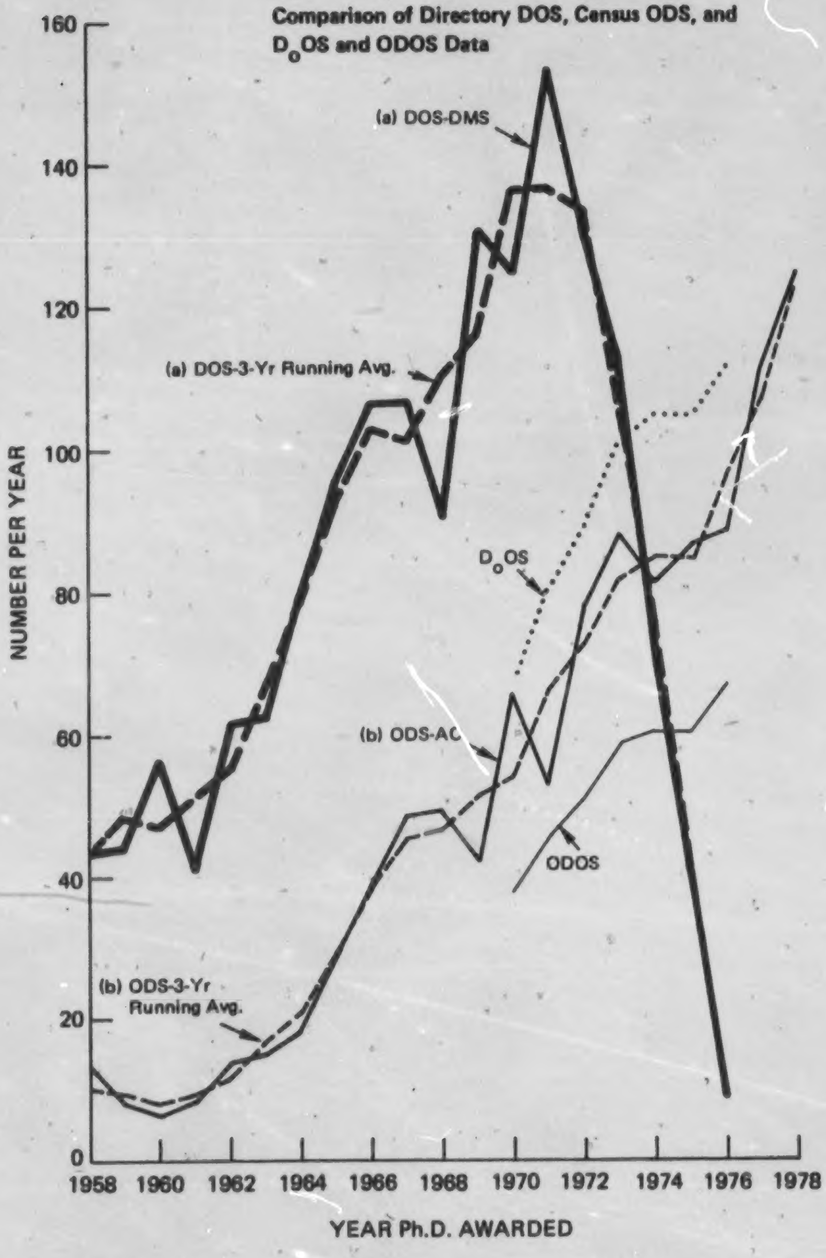

FIGURE 12 Production rates of (a) Doctoral Oceanography-Employed Scientists (DOS) according to the modified *Directory of Marine Scientists* (DMS) data compared with (b) production of Oceanography-Trained Doctoral Scientists (ODS) according to the Annual Census (AC).

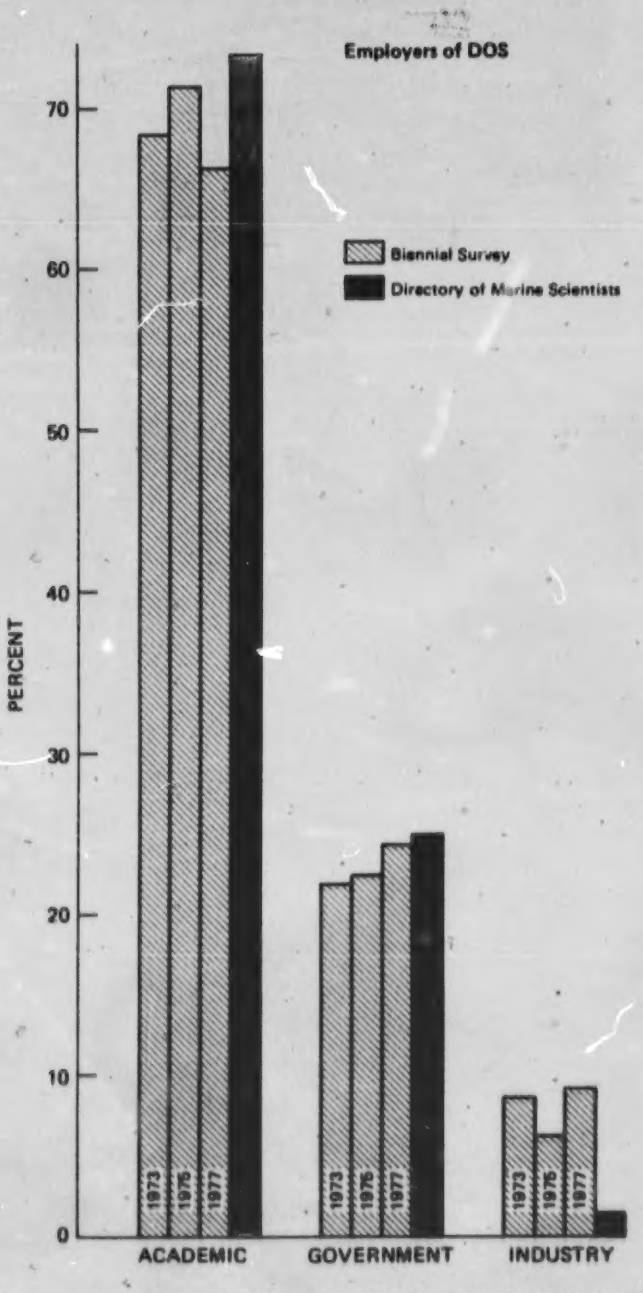

FIGURE 13 Employment sector of Doctoral Oceanography-Employed Scientists (DOS) according to the modified *Directory of Marine Scientists* (DMS) data and Biennial Surveys--(a) BS-73, (b) BS-75, and (c) BS-77.

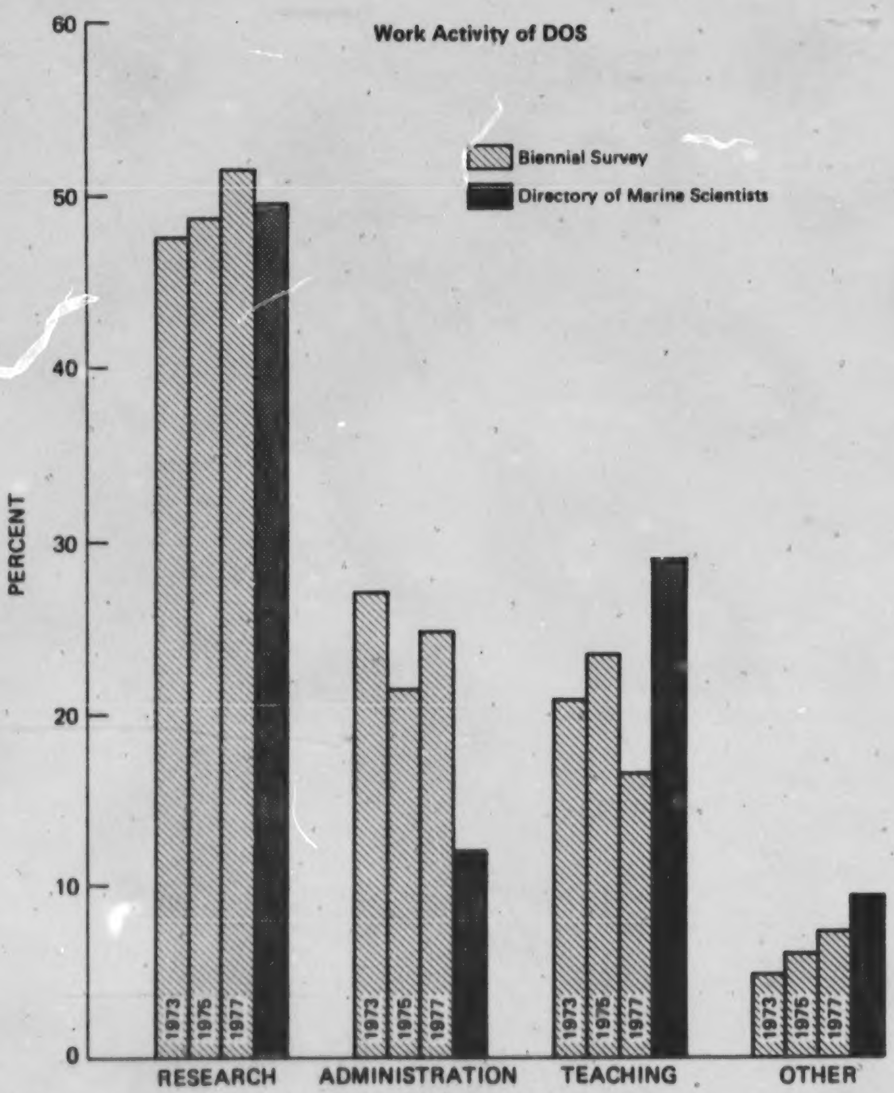

FIGURE 14 Primary work activity of Doctoral Oceanography-Employed Scientists (DOS) according to the modified *Directory of Marine Scientists* (DMS) data and Biennial Surveys--(a) BS-73, (b) BS-75, and (c) BS-77).

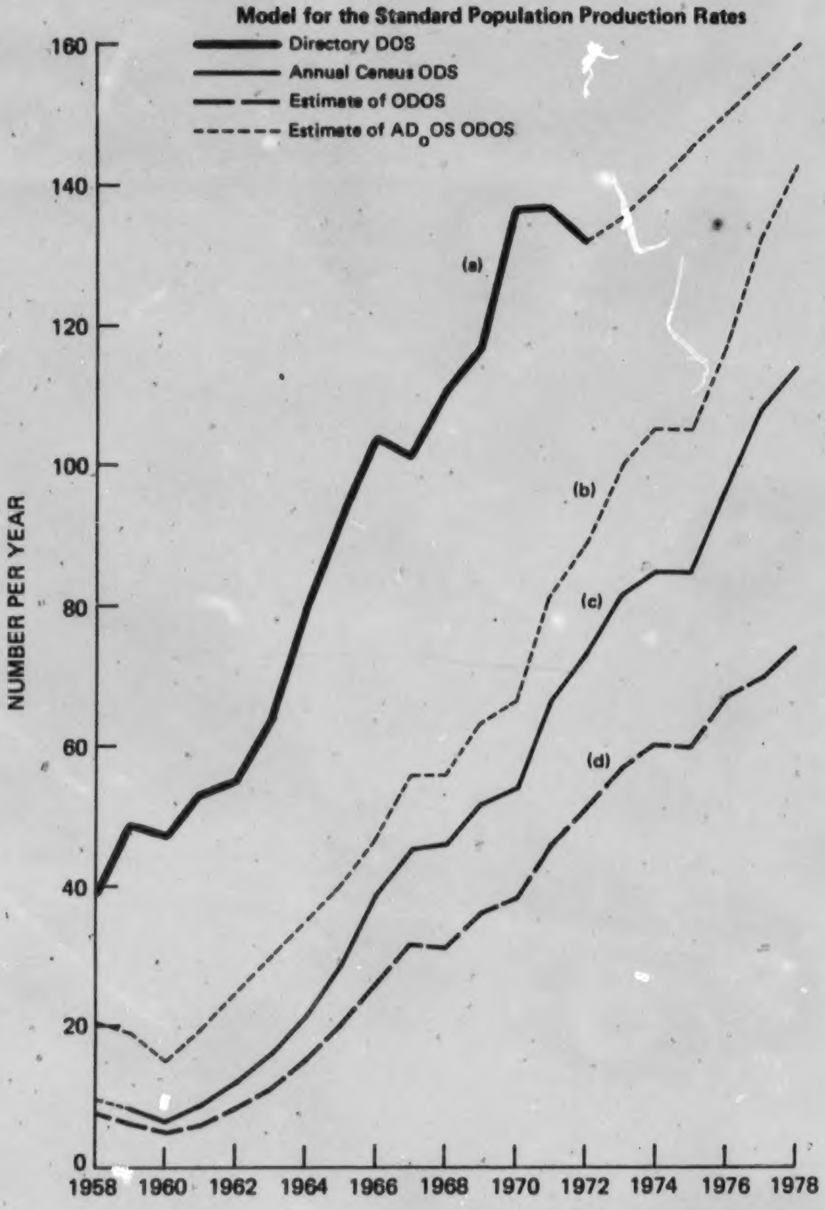

FIGURE 15 Production rates according to the "Standard" Population Model. (a) DOS, (b), D_oOS = ODOS + AD_oOS, (c) ODS, and (d) ODOS. See text.

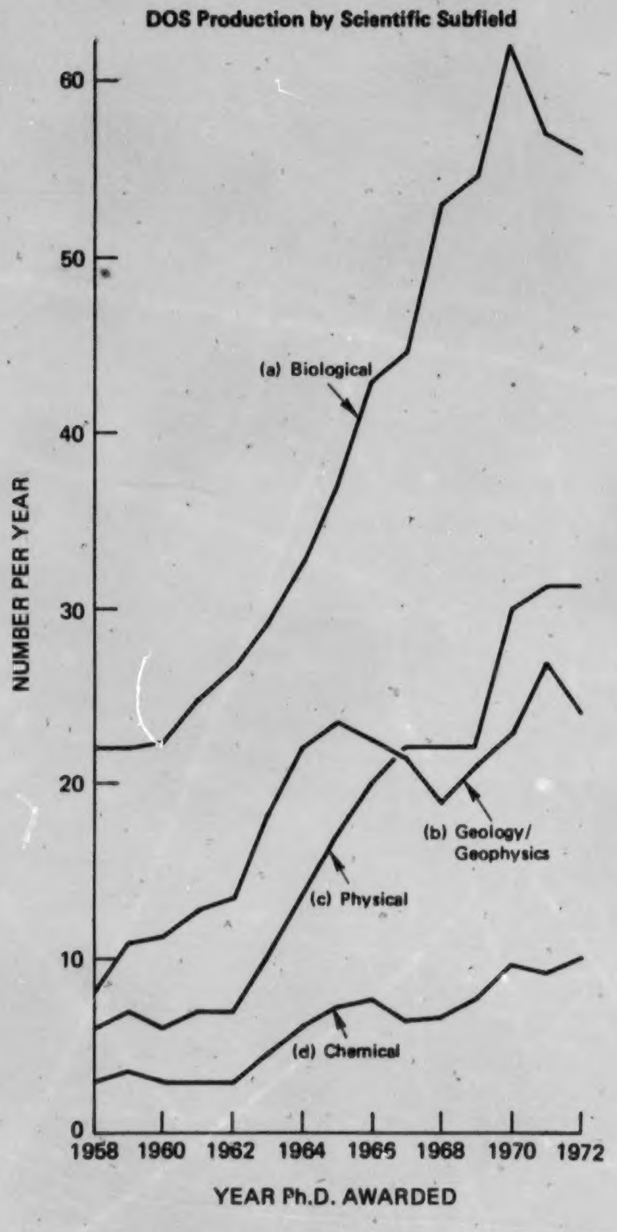

FIGURE 16 Production rates by subfields from 1958 to 1972 of (a) biological, (b) geological/geophysical, (c) physical, and (d) chemical Doctoral Oceanography-Employed Scientists (D according to the modified *Directory of Marine Scientists* (DMS) data.

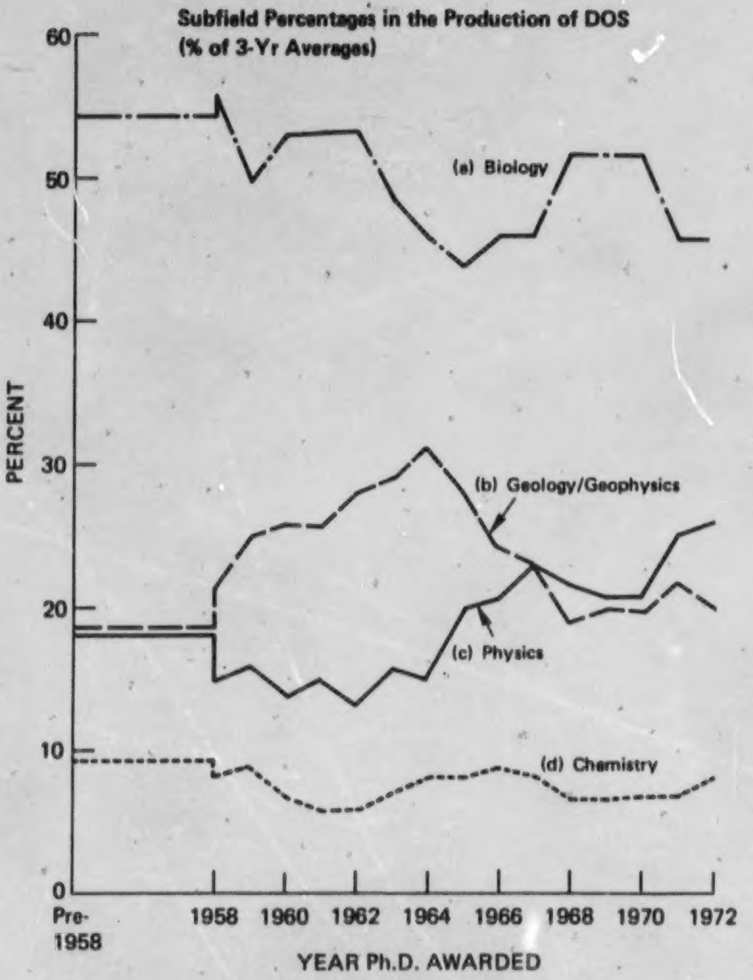

FIGURE 17 Percentage of production by subfields of (a) biology, (c) geology/geophysics, (c) physics, and (d) chemistry, in the Doctoral Oceanography-Employed Scientists (DOS) produced according to the modified *Directory of Marine Scientists* (DMS) data.

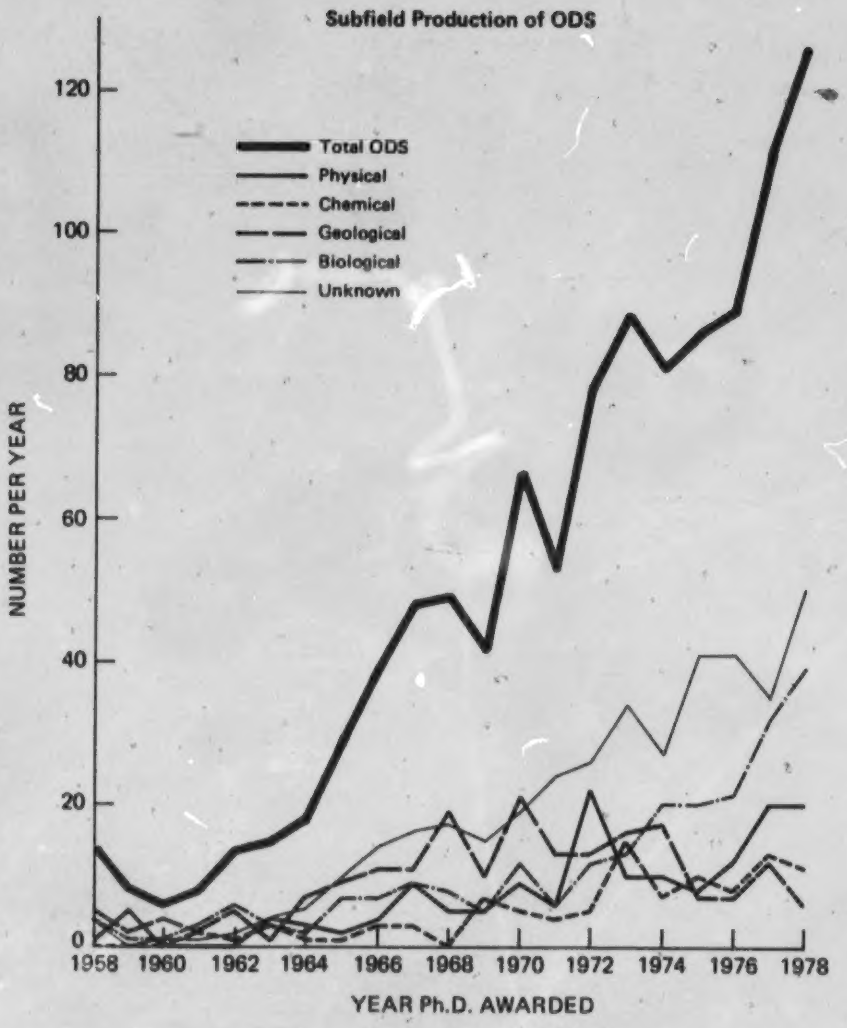

FIGURE 18 Production rates of Oceanography-Trained Doctoral Scientists (ODS) and inferred subfield rates for (a) biology, (b) geology/geophysics, (c) physics, and (d) chemistry according to the Annual Census (AC).

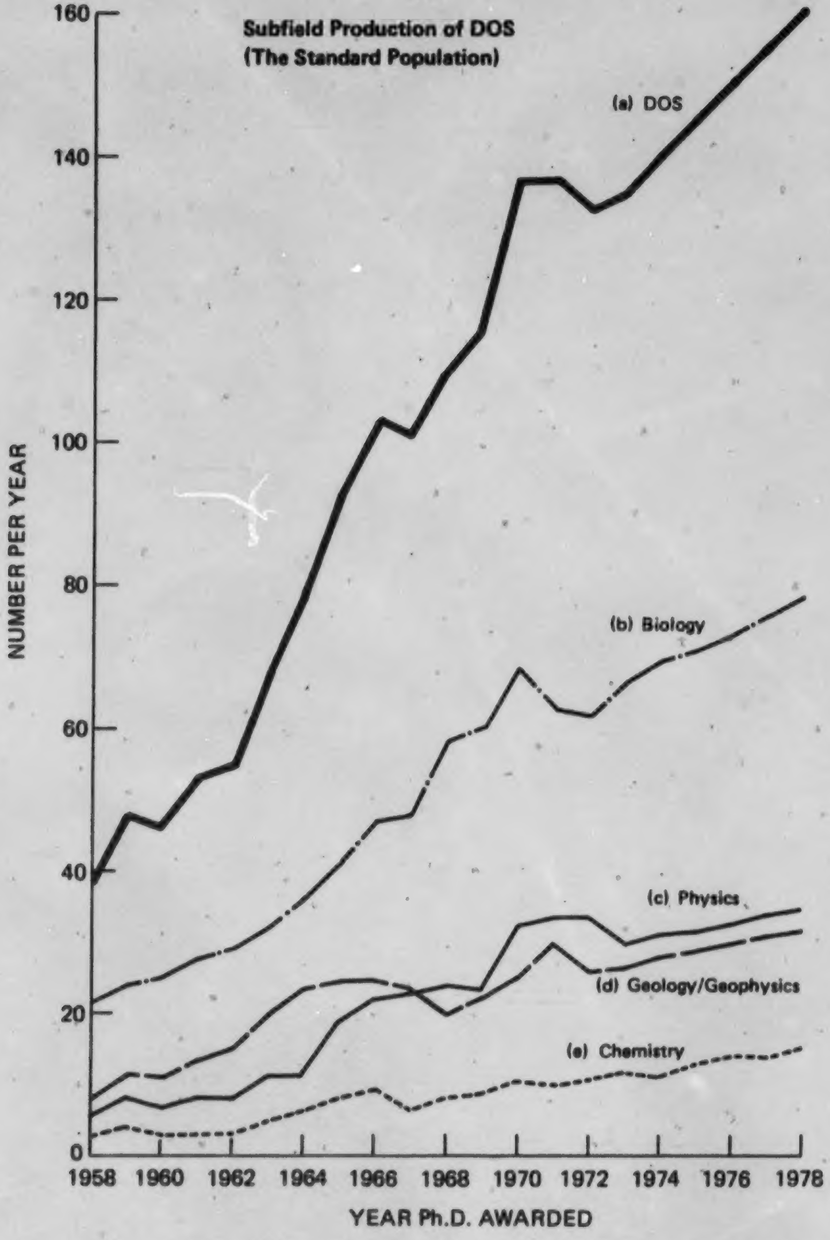

FIGURE 19 Production rates by subfield of Doctoral Oceanography-Employed Scientists (DOS): (a) total, (b) biological, (c) geological/geophysical, (d) physical, and (e) chemical for the "Standard" Population.

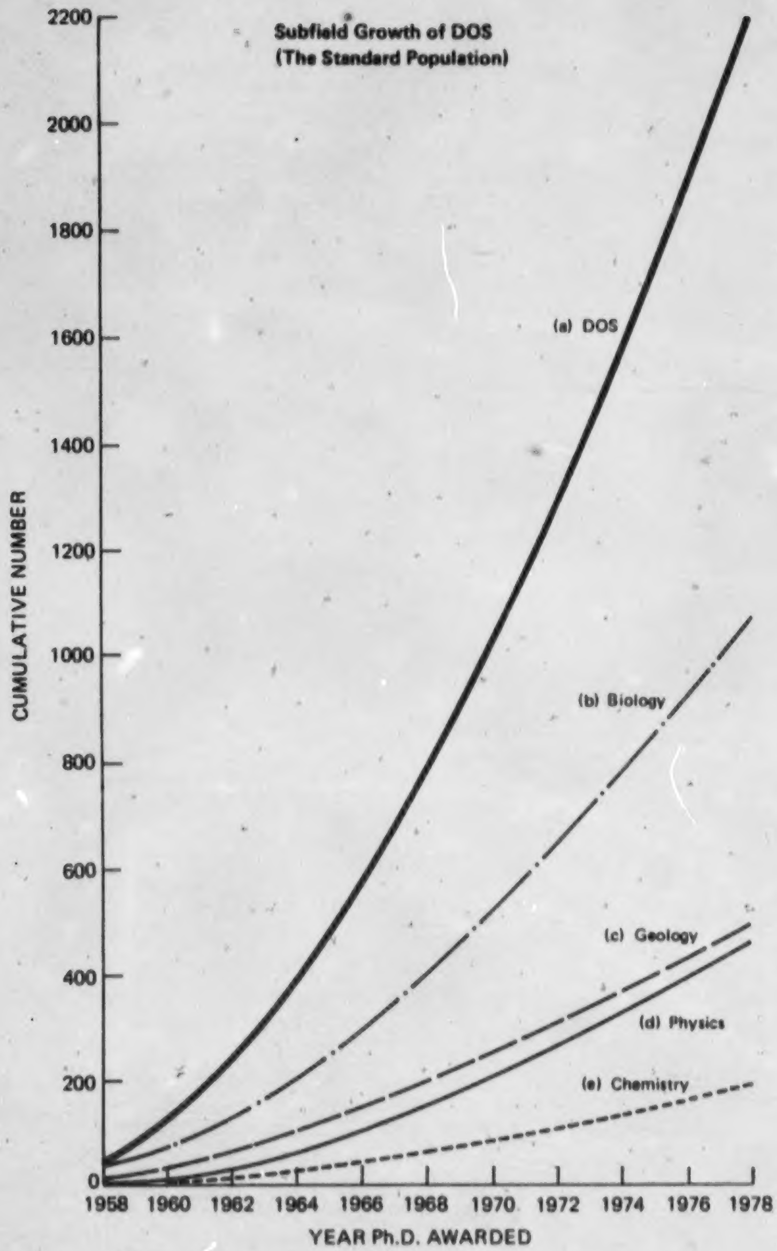

FIGURE 20 Population growth by subfield of Doctoral Oceanography-Employed Scientists (DOS): (a) total, (b) biological, (c) geological/geophysical, (d) physical, and (e) chemical for the "Standard" Population.

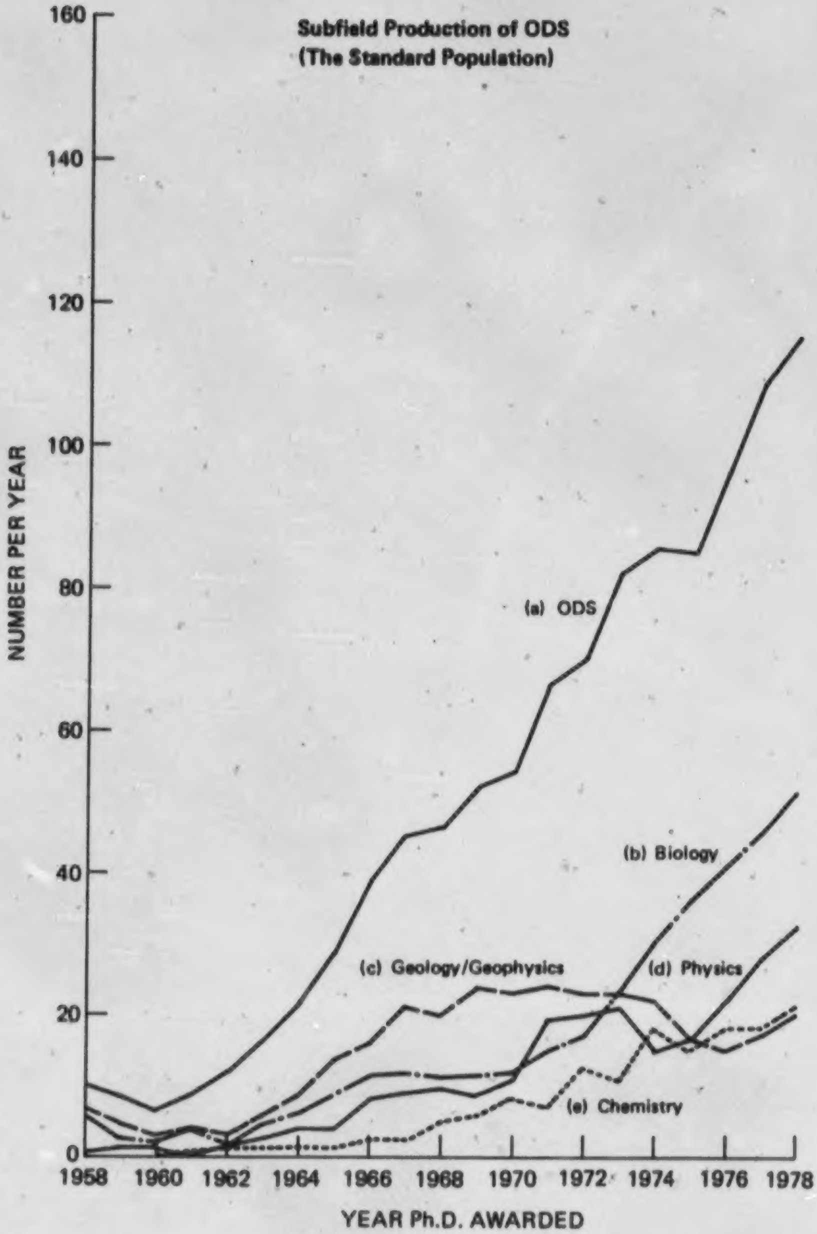

FIGURE 21 Production rates by subfield of Oceanography-Trained Doctoral Scientists (ODS): (a) total, (b) biological, (c) geological/geophysical, (d) physical, and (e) chemical for the "Standard" Population.

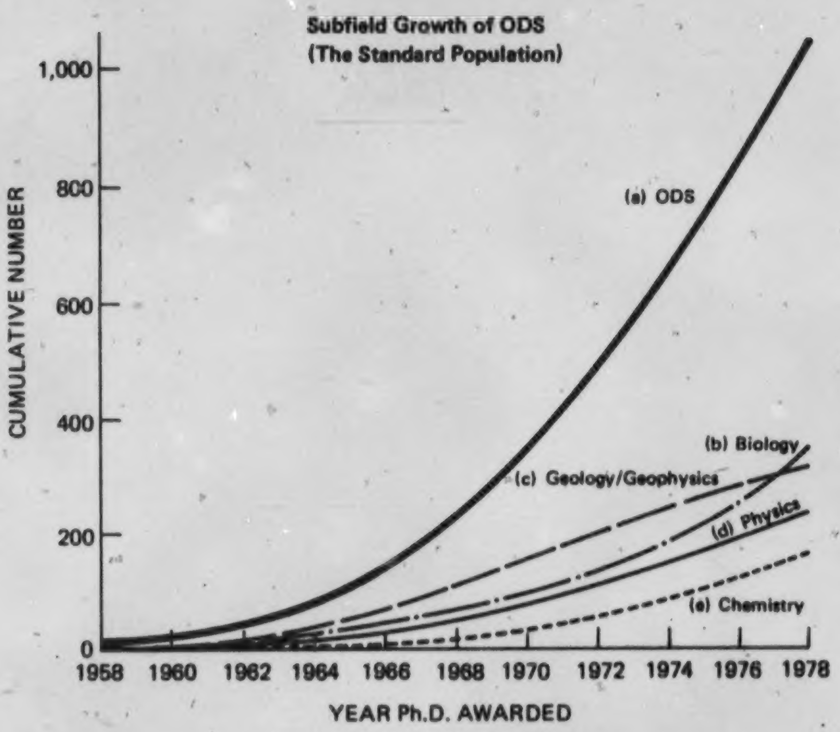

FIGURE 22 Population growth by subfield of Oceanography-Trained Doctoral Scientists (ODS): (a) total, (b) biological, (c) geological/geophysical, (d) physical, and (e) chemical for the "Standard" Population.

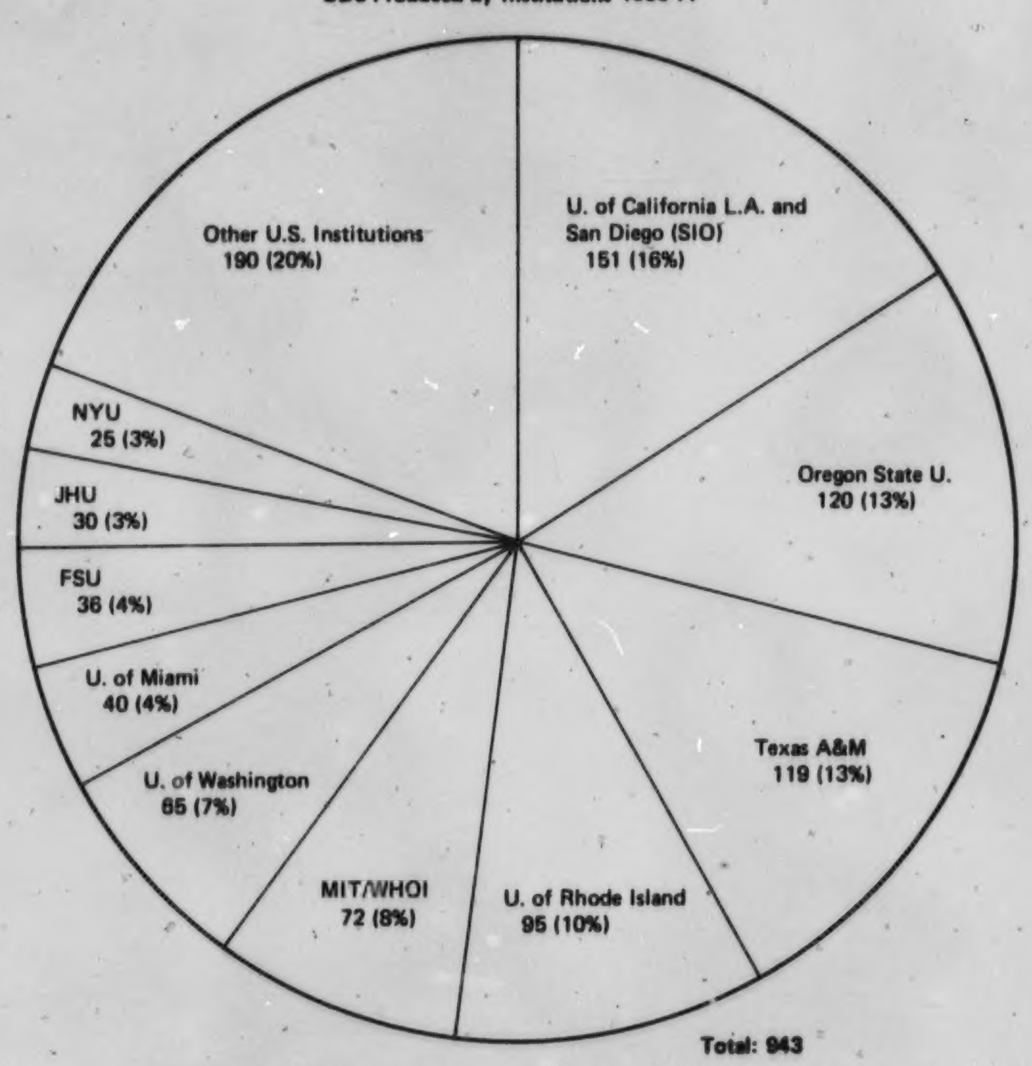

FIGURE 23 Percentage and number of Oceanography-Trained Doctoral Scientists (ODS) originating from the most productive institutions in 1958-1977 according to the Annual Census (AC).

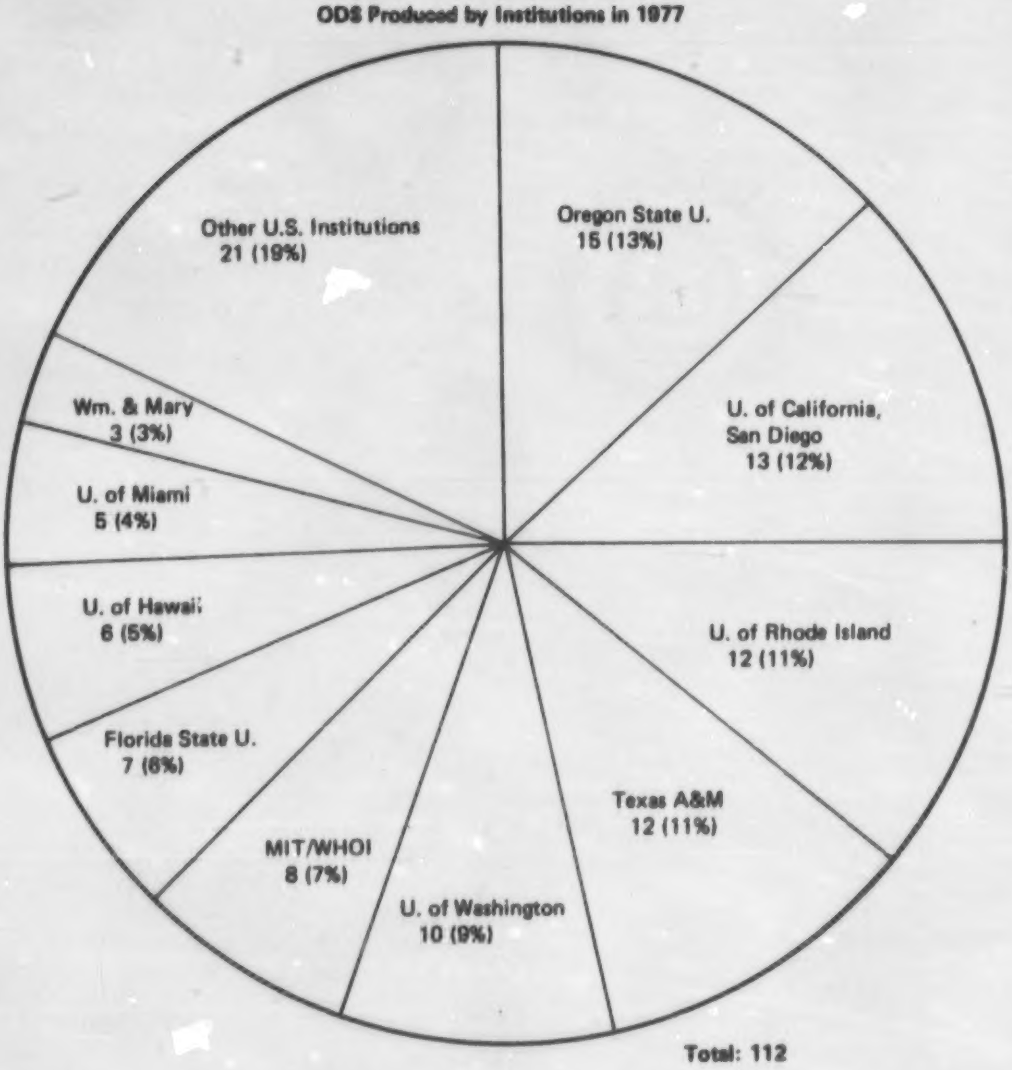

FIGURE 24 Percentage and number of Oceanography-Trained Doctoral Scientists (ODS) originating from the most productive institutions for 1977 according to the Annual Census (AC).

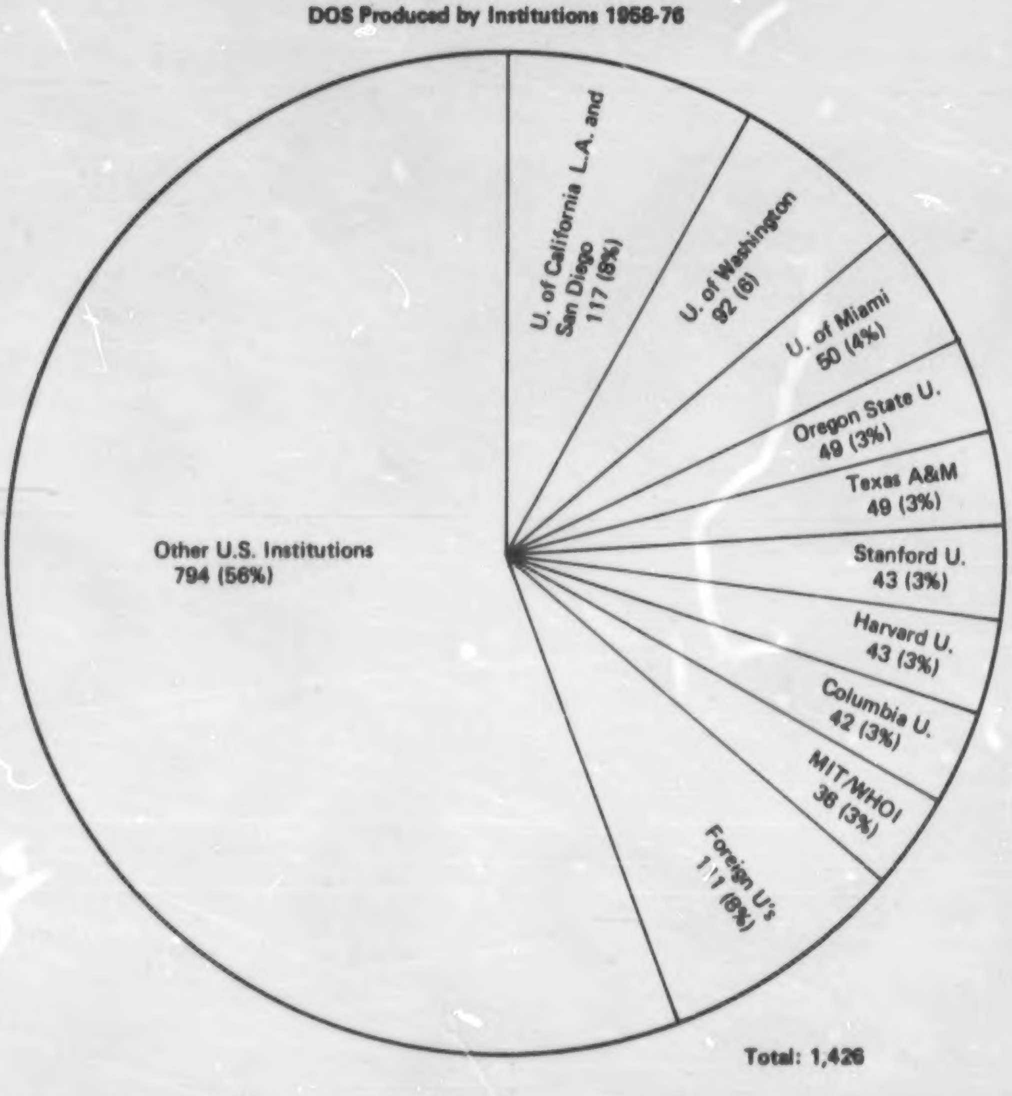

FIGURE 25 Percentage and number of Doctoral Oceanography Employed Scientists (DOS) originating from the most productive institutions in 1958-1976 according to the modified *Directory of Marine Scientists* (DMS) data.

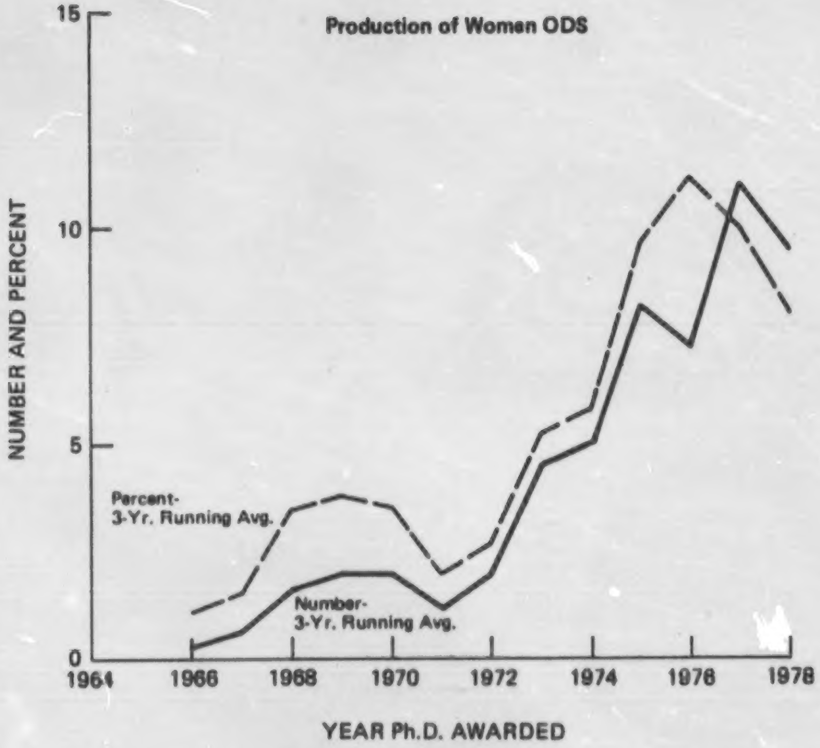

FIGURE 26 Production rate (number and percentate) of women Oceanography-Trained Doctoral Scientists (ODS), 1966-1978 according to the Annual Census.

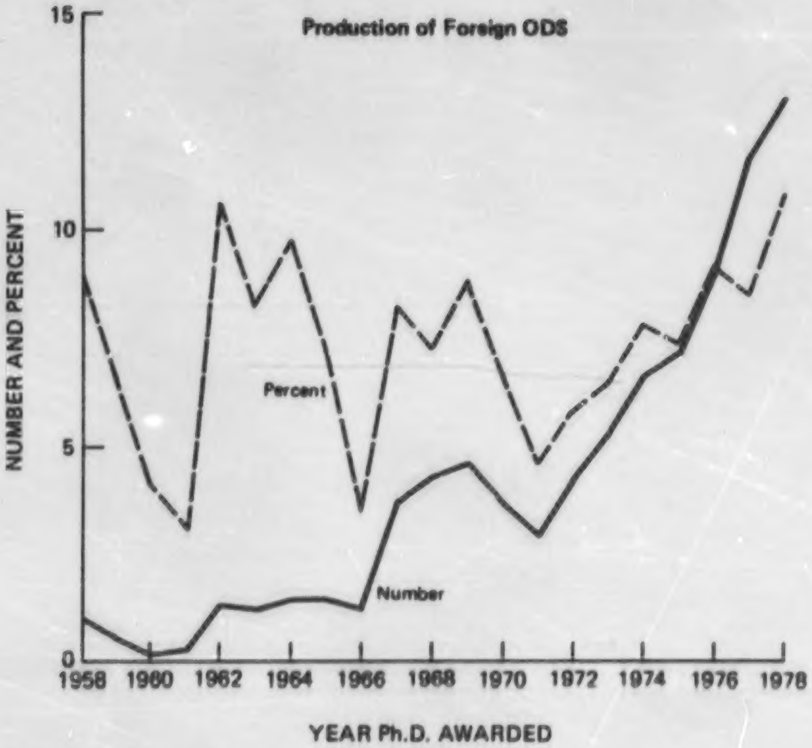

FIGURE 27 Production rate (number and percentage) of foreign (non-U.S. and non-immigrant) Oceanography-Trained Doctoral Scientists (ODS), 1958-1978 according to the Annual Census.

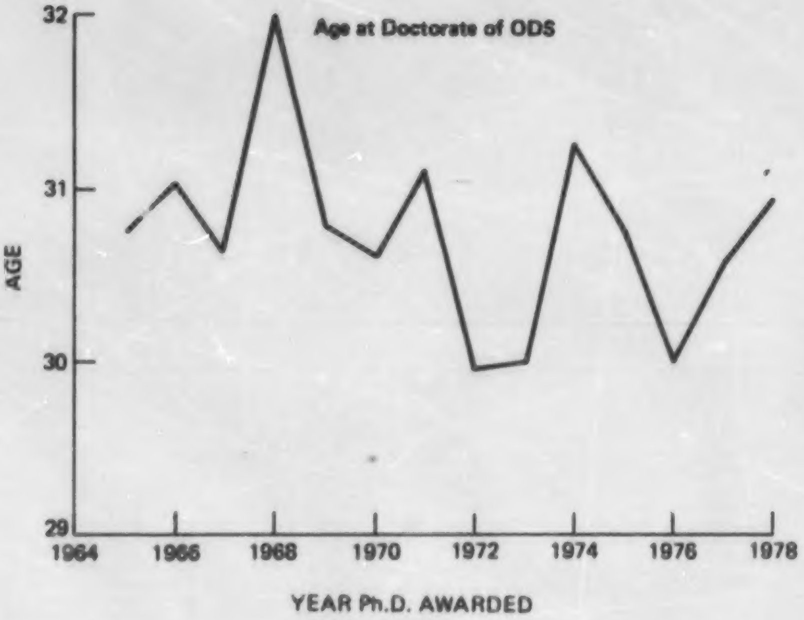

FIGURE 28 Average age at doctorate of Oceanography-Trained Doctoral Scientists (ODS), 1965-1978 according to the Annual Census.

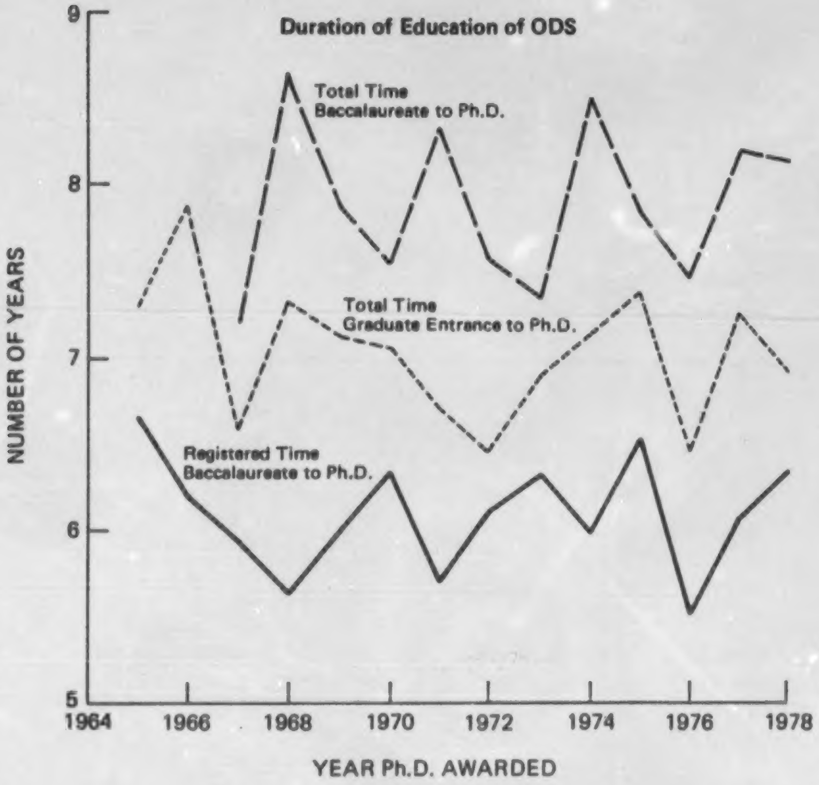

FIGURE 29 Length of time required for education of Oceanography-Trained Doctoral Scientists (ODS), 1965-1978 according to the Annual Census.

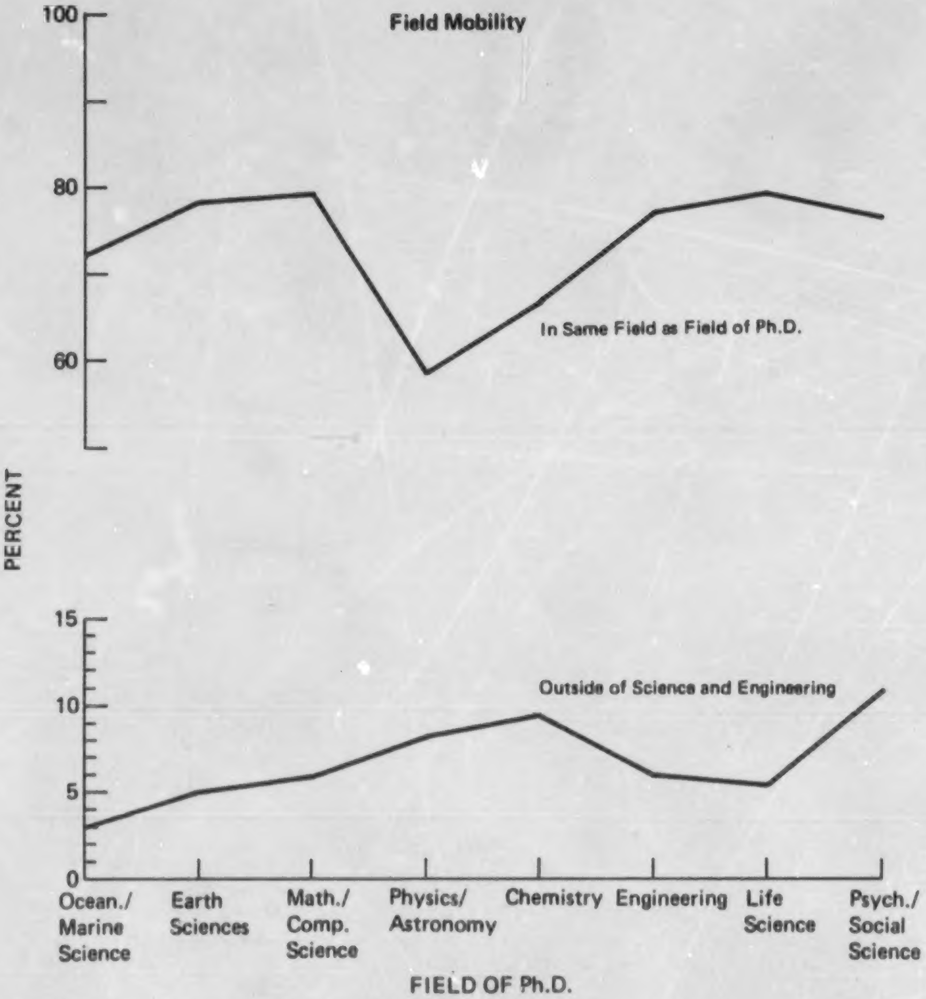

FIGURE 30 Field mobility of Doctoral Oceanography-Employed Scientists (DOS) (employed in same field and left science) compared with scientists in major fields, 1977 according to the Biennial Survey.

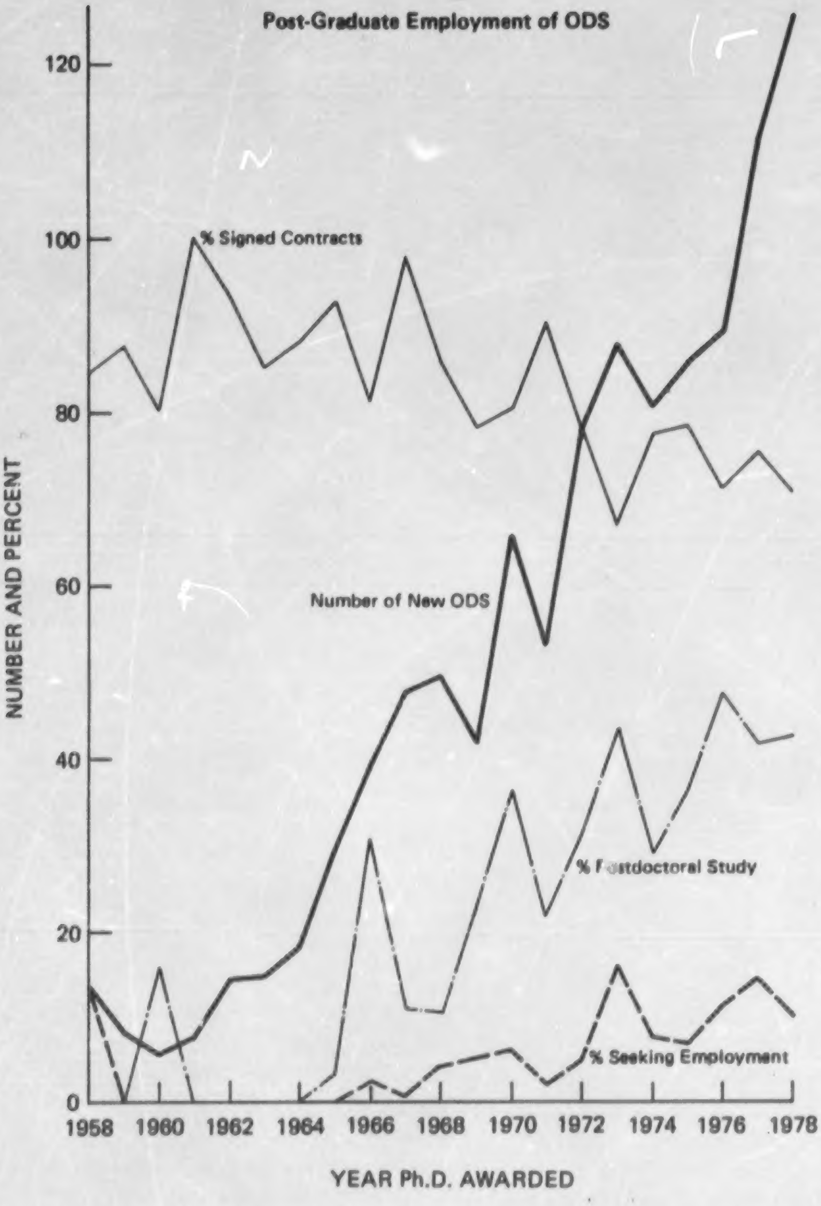

FIGURE 31 Postgraduate employment of Oceanography-Trained Doctoral Scientists (ODS), 1958-1978 according to the Annual Census.

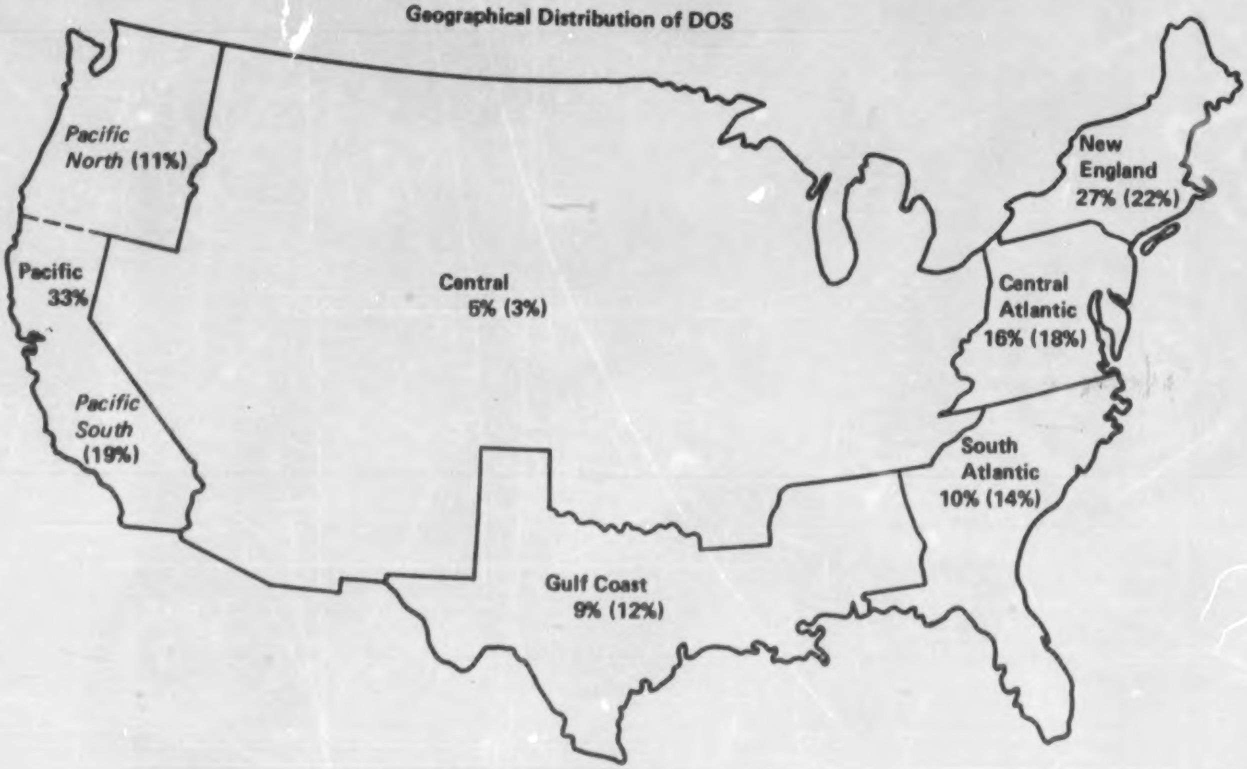

FIGURE 32 Geographic distribution of Doctoral Oceanography-Employed Scientists (DOS) according to the *U.S. Directory of Marine Scientists* (DMS) and the 1977 Biennial Survey (BS).

Note: South Atlantic includes Puerto Rico and the Virgin Islands; Pacific North includes Alaska; Pacific South includes Hawaii, the Canal Zone, and Guam. Numbers in ( ) are DMS figures. Others are BS figures.

TABLE 1 Numbers for Classes of Doctoral Scientists in Oceanography in 1978

Year Ph.D. Degree Granted	ODS^{a,c}	ODOS^{c}	ODAS^{c}	AD_oOS^{c}	AD_aOS^{c}	DOS^{b}
Pre-1958^{d}	41	28	13	128	223	389
(% of DOS)		7%		33%	60%	100%
1958-1965	113	80	33	126	276	482
(% of DOS)		17%		26%	57%	100%
1966-1972	375	263	112	195	379	837
(% of DOS)		32%		23%	45%	100%
1973-1978	572	402	170	301	182	885
(% of DOS)		45%		34%	21%	100%
TOTALS:	1101	773	328	750	1070	2593
(% of DOS)		30%		29%	41%	100%

[a] ODS = ODOS + ODAS.

[b] DOS = ODOS + AD_oOS + AD_aOS.

[c] Recall that ODS, Oceanography-Trained Doctoral Scientists; ODOS, Oceanography-Trained Doctoral Oceanography-Employed Scientists; ODAS, Oceanography-Trained Doctoral Alternately Employed Scientists; AD_oOS, ADOS who perceive of themselves as working oceanographers; AD_aOS, ADOS who do not perceive of themselves as working oceanographers; DOS, Doctoral Oceanography-Employed Scientists.

[d] For details on pre-1958 estimates, see Appendix A.

TABLE 2 Field Mobility--Field of Degree as Related to Field of Employment[a]

Alternate (Non-oceanography) Degree	AD$_O$OS's Who Entered Oceanography	ODS's Who Left Oceanography to Become ODAS's	Alternate Field of Employment
Other earth sciences	171	116	Other earth sciences
Mathematics/computer science	5	0	Mathematics/computer science
Physics/astronomy	128	14	Physics/astronomy
Chemistry	35	7	Chemistry
Engineering	38	0	Engineering
Life sciences	412	97	Life sciences
Psychology/social sciences	12	0	Psychology/social sciences
Nonscience/unknown	0	26	Nonscience/unknown
		24	Unemployed
TOTAL	801	284	

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[a] Sources of Alternately Trained Doctoral Oceanography-Employed Scientists (AD$_O$OS) and "Sinks" Oceanography-Trained Doctoral Alternate-Employed Scientists (ODAS)

Includes postdoctoral appointees, full-time and part-time employed, those who were awarded marine science/other as well as oceanography Ph.D. degrees, and those awarded Ph.D. degrees in all sciences from 1934 to 1976, who were employed in 1977.

Data Source: *NRC Biennial Survey of Doctorate Recipients*, Data Appendix Table B.25.

TABLE 3 Numbers of Oceanography-Trained Doctoral Scientists (ODS) Produced by 51 U.S. Institutions, with Oceanography Ph.D. Programs, 1958-1976 and 1977[a]

Institution	1958-1976	1977
Alaska, University of	9	
Brown University	1	
California Institute of Technology	1	
California, University of, at Los Angeles and San Diego[b]	138	13
California, University of, at Riverside	1	
California, University of, at Santa Cruz	1	
Chicago, University of	5	2
Columbia University	15	
Colorado, University of Boulder		1
Connecticut, University of	2	1
Cornell University	2	
Delaware, University of	3	
Duke University	1	1
Florida State University	29	7
Harvard University	5	
Hawaii, University of	18	6
Illinois, University of at Urbana-Champaign	3	
Johns Hopkins University	30	
Lehigh University	1	1
Louisiana State University & A&M College	5	1
Maine, University of	2	
Massachusetts Institute of Technology/WHOI[c]	64	8
Miami, University of	35	5
Michigan State University	1	

Institution	1958-1975	1977
Michigan, University of	17	2
Naval Postgraduate School	1	1
New Hampshire, University of		1
New York University	23	2
North Carolina University at Chapel Hill	5	1
North Carolina State University at Raleigh	5	1
NOVA University	1	
Ohio State University	1	
Old Dominion College		1
Oregon State University	105	15
Princeton University	3	
Rensselaer Polytechnic Institute	1	
Rhode Island, University of	83	12
Rice University	1	
Rochester, University of		1
South Carolina, University of	2	1
Southern California, University of	11	1
Stanford University	1	
State University of New York	1	
Texas A&M University	107	12
Utah State University	1	
Virginia, University of	2	
Washington, University of	55	10
William & Mary, College of	15	3
Wisconsin, University of	16	1
Yale University	2	1
TOTAL	831	112

[a] Source: NRC Annual Census, Data Appendix, Table B.3.
[b] ODS program shifted from Los Angeles to San Diego in 1961.
[c] Joint program started in 1968.

TABLE 4 Number of Doctoral Oceanography-Employed Scientists (DOS) Produced by 54 U.S. Institutions Graduating More than 5 Ph.D. Degrees from 1958 through 1976[a]

Institution	Total
Alaska, University of	5
Arizona, University of	6
Brown University	7
California Institute of Technology	5
California, University of, at Berkeley	37
California, University of, at Davis	13
California, University of, at Los Angeles[b]	20
California, University of, at San Diego[b]	97
California, University of, at Santa Barbara	10
Case Western Reserve University	5
Chicago, University of	17
Colorado State University	5
Columbia University	42
Connecticut, University of	7
Cornell University	26
Delaware, University of	9
Duke University	12
Florida State University	28
Florida, University of	15
George Washington University	10
Georgia, University of	9
Harvard University	43
Hawaii, University of	18
Illinois, University of, at Urbana-Champaign	20
Indiana University, Bloomington	6
Johns Hopkins University	30
Kansas, University of	8
Louisiana State University & A&M College	14
Maryland, University of	9
Massachusetts Institute of Technology/WHOI	36
Miami, University of	50
Michigan, University of	22
Mississippi State University	5
New York, State University of	24
North Carolina State University at Raleigh	16
North Carolina University at Chapel Hill	22
Northwestern University	6
Ohio State University	7
Oregon, University of	49
Oregon State University	6
Pennsylvania State University	13
Pittsburgh, University of	6
Princeton University	11
Rhode Island, University of	34
Rice University	13
Rutgers--The State University	17
Southern California, University of	34
Stanford University	43
Texas A&M University	49
Texas University of, at Austin	15
Washington, University of	92
William & Mary, College of	12
Wisconsin, University of at Madison	29
Yale University	18
TOTAL	1152

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[a] Source: Directory of Marine Scientists, Data Table B.28.

[b] Combined in Table 3 but not here because, for the most part, the Los Angeles Ph.D.'s are not the result of an oceanography Ph.D. program. Both Los Angeles and San Diego continue to produce DOS.

TABLE 5 Doctoral Scientists in Oceanography (DOS) from Selected Institutions by Different Classifications (1958-1973)[a]

	Number of Degrees Reported			
	Annual Census	*U.S. Directory of Marine Scientists*		
Institution	I-ODS	II-ODOS	III-ADOS	IV-DOS
Group A (ODS ODOS)				
University of Michigan	10	6	22	28
Stanford University	1	0	49	49
University of California at San Diego	90	88	12	100
University of Maryland	0	0	15	15
Rutgers--The State University	0	0	18	18
Group B (ODS ODOS)				
Massachusetts Institute of Technology/Woods Hole Oceanographic Institution	42	20	25	45
University of Washington	40	23	77	100
Group C (ODS ODOS)				
University of Miami	24	7	42	49
University of California at Los Angeles	16	1	24	25
University of California at Berkeley	0	0	41	41
Group D (ODS ODOS)				
Duke University	0	7	3	10
University of Florida	0	10	8	18
Harvard University	3	26	21	47
TOTALS	225	188	358	545

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[a] Sources: NRC Annual Census, Data Appendix Table B.3, and *U.S. Directory of Marine Scientists*. Data do not match numbers reported in Table B.2B because all Ph.D.'s listed in the *Directory* are included in the above table, but only DOS, as defined by this study, are included in Table B.2B.

TABLE 6 Numbers and Types of Oceanography Degree Programs by Degree Title[a,b]

Degree Title Category[c]	Numbers and Types of Degree Programs								Subtotals			Totals
	BS MS Ph.D.	MS and Ph.D.	Only Ph.D.	BS and Ph.D.	BS and MS	Only MS	Only BS	AS/AA	Ph.D. Prog.	MS Prog.	MS Prog.	
Oceanography/Marine Science	15	30	1	3		4	4		49	49	22	120
Marine-Related Sciences			34		7		10		34	7	17	58
Other Sciences	10	16	34	2	16	3	15		62	45	43	150
Associate Degree								20				20
TOTALS	25	46	69	5	23	7	29	20	145	101	82	348

[a] Data Sources: *University Curricula in the Marine Sciences and Related Fields*, Academic Years 1975-76, 1976-77; Interagency Committee on Marine Science and Engineering; and *Curricula in the Atmospheric and Oceanographic Science* 1976; American Meteorological Society.

[b] Information from 157 institutions offering Ocean Science/Marine Science Programs leading to a degree.

[c] Definitions: Marine-Related Sciences--Degree title: Marine Geology, Marine Biology, Meteorology, Ocean Engineering, etc. Other Sciences--Degree title: Biology, Physics, Geology, Chemistry, etc.

TABLE 7 Selected Demographic Characteristics of Doctoral Oceanography-Employed Scientists (DOS) Sampled by the Biennial Survey in 1977 Compared with Ph.D.'s in Major Fields[a]

	Field of Degree								
	All Fields	Ocean./ Mar. Sci.	Other Earth Sci.	Math/ Comp. Sci.	Physics/ Astron.	Chem.	Eng.	Life Sci.	Psych./ Soc. Sci
Sex (%)									
Male	90	95	96	93	97	93	99	86	82
Female	10	5	4	7	3	7	1	14	18
Racial Group (%)									
White/Caucasian	89	93	93	88	88	90	84	89	91
Minority group	6	4	4	6	6	6	12	6	4
No report	5	3	3	6	6	4	4	4	5
Calendar Year of Ph.D.(%)									
1934-1939	3	0	4	2	3	5	1	3	2
1940-1944	3	1	2	2	2	6	2	4	2
1945-1949	3	0	3	3	3	6	2	3	3
1950-1954	8	2	8	6	10	11	6	9	8
1955-1959	9	[illegible]	10	7	10	11	7	10	9
1960-1964	[illegible]	[illegible]	15	12	15	14	13	13	11
1965-1969	22	32	20	25	24	21	29	21	20
1970-1974	30	47	26	33	27	21	32	29	34
1975-1976[b]	9	11	11	10	6	6	8	9	11
Citizenship (%)									
U.S.	94	95	94	93	92	94	90	94	97
Foreign	6	5	6	7	8	6	10	5	3
Total Individuals	295,830	1020	8560	7360	26,430	44,620	44,330	75,310	78,210

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[a] Data Source: NRC Biennial Survey of Doctorate Recipients, 1977.

[b] The drop in numbers is partially due to smaller (2-year) 1975-1976 cohort.

TABLE 8 Racial Background

Racial/Ethnic Group	Number		Percent Reporting	
	ODS[a]	DOS[b]	ODS[a]	DOS[b]
White/Caucasian	253	1413	94	96
Black/Afro-American	0	0		
American Indian	2	0	1	
Spanish-American/Mexican-American	2		1	
Puerto Rican-American	2		1	
Asian	11	58	4	4
Total Known	270	1471	101	100
Unknown or No Report	30	62		
TOTAL	300	1533		

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[a] Oceanography-Trained Doctoral Scientists who were awarded Ph.D. degrees in oceanography between 1973-1976 and who were U.S. citizens or held permanent visas, according to Women and Minority Ph.D.s in the 1970's: A Data Book, National Research Council, 1977.

[b] Doctoral Oceanography-Employed Scientists sampled by the 1977 Biennial Survey.

TABLE 9 Employment Status of Doctoral Oceanography-Employed Scientists (DOS) in 1977 Compared with Major Fields[a]

Field	Employment Status (%)					
	Employed		Not Employed	Seeking	Not Seeking	Retired
	In Science	Out of Science				
All Fields	82.6	12.0	5.4	1.1	1.0	3.3
Oceanography/ Marine Sciences	91.3	6.3	2.4	1.8	0.3	0.3
Other Earth	86.9	8.2	4.9	0.9	0.2	3.8
Math/Computer	88.1	7.7	4.2	1.0	0.7	2.5
Physics/Astro	82.4	13.3	4.3	1.1	0.8	2.5
Chemistry	79.9	13.6	6.5	1.1	1.0	4.4
Engineering	89.8	7.7	2.5	0.6	0.5	1.5
Life Sciences	80.3	12.5	7.2	1.3	1.6	4.3
Psychology/ Social Sciences	80.6	14.1	5.3	1.3	0.8	3.2

[a] Data Source: NRC Biennial Survey (of Doctorate Recipients), 1977.

TABLE 10 Median Annual Salaries of Doctoral Oceanography-Employed Scientists (DOS) Compared with Salaries in Major Science Fields in 1973, 1975, and 1977[a]

Year	Field of Employment								
	All Fields	Oceanog./ Mar. Sci.	Other Earth Sci.	Math/ Comp. Sci.	Physics/ Astron.	Chem.	Eng.	Life Sci.	Psych./ Soc. Sci.
1973	20,746	19,608	20,789	19,723	21,054	20,919	22,282	20,002	19,059
1975	23,153	22,106	23,691	21,779	23,653	23,908	25,183	22,181	21,891
1977	25,584	24,099	26,247	24,024	26,365	26,370	28,541	24,619	23,834

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[a] Data Source: NRC Biennial Survey (of Doctorate Recipients).

APPENDIX A: DATA SETS, DEFINITIONS, AND SUPPLEMENTAL NOTES

A. ANNUAL CENSUS (SURVEY OF EARNED DOCTORATES)

The annual NRC *Survey of Earned Doctorates* (referred to in this report as the Annual Census) obtains information each year from almost all individuals in the United States who receive a Ph.D. degree. The Annual Census is conducted by the National Research Council for the National Science Foundation, the U.S. Office of Education, the National Institutes of Health, and the National Endowment for the Humanities. The Annual Census questionnaire is filled out by graduates when they complete all requirements for their doctoral degrees. For this study, oceanography doctoral scientists (ODS) in the Annual Census are defined as the individuals who, upon the completion of their doctorate work, checked the oceanography or the marine sciences/other box on the Annual Census questionnaire as their field of doctoral speciality.

The Annual Census data provide information on the production rate of doctorates by fine field, broad field, and broad summary field such as the life sciences and physical sciences; the number of institutions that awarded Ph.D. degrees; the production rate of doctorates by individual institutions; the educational background and postdoctorate plans of recent Ph.D. classes; the predoctoral degree fields of Ph.D.'s; and demographic characteristics of Ph.D. recipients including sex, race, age at receipt of degree, and citizenship.

A strong feature of the Annual Census data is its inclusion of almost all individuals who received a Ph.D. degree in the United States from 1958 to the present. The response rate has consistently been 97 percent or better.

Data collected from Ph.D. recipients are summarized each year for degrees granted at U.S. institutions from July 1 to the following June 30. The data do not include professional degrees such as M.D., D.D.S., and D.V.M.

Although the Annual Census has been conducted since 1958, data for some categories are not available as far back as 1958 because the category was added later. Furthermore, since 1969 there have been several additions and deletions of fine fields and some regrouping of fine fields within fields. Therefore, some of the data may not be rigorously comparable. For example, from 1972 to 1976, the environmental sciences fine field was included under the broad field life sciences. In 1977, it is included under the broad field physical sciences and under the field earth sciences.

Questionnaires are sent to all U.S. institutions known to grant research doctorates, and the mailing list is continually updated. Information is obtained from both United States citizens and foreign citizens, whether in the United States with temporary or permanent visas.

The fine fields oceanography and marine sciences/other are included under the broad field of earth, environmental, and marine sciences, which, in turn, is included under the broad summary field of physical sciences.

Comparisons made between 1973 data on ethnic/racial group and data for 1974 onward may not be significant because of the large number of nonresponses to the question in 1973. Furthermore, the ethnic/racial question was changed slightly in 1977. Therefore, care is needed when attempting to use these data for trend analyses.

In some cases the Dean or an administrative assistant filled out the questionnaires for the graduates. As a result, some information on the questionnaire may be missing, e.g., B.A. or M.S. speciality. This procedure may account for the large number of individuals who did not report their B.A. or M.S. speciality.

Subfield breakouts of oceanography--biological, chemical, physical, and geological--were not specified at the Ph.D. level. Therefore, an attempt was made to estimate these breakouts at the Ph.D. level using the field of baccalaureate degree and field of masters degree information from the questionnaire. The oceanography subfield at the Ph.D. level was estimated from the number of individuals who earned a B.A./B.S. or an M.A./M.S. in a particular subfield. Identifying the subfield at the masters level was possible only for those who did not earn that degree in oceanography, which is indicated without the subfield breakout. In order to divide this speciality among the subfields, the data from the baccalaureate level were tabulated and the percentages were calculated for each subfield.

The oceanography subfield was rarely reported at the baccalaureate level, probably because of the lack of baccalaureate oceanography curricula. When this speciality was reported, the data were distributed evenly among the subfields. The resulting percentages from baccalaureate data were then used to estimate the breakout of the oceanography speciality at the masters level. For example: if the subfield was listed as "anatomy" the individual would be placed under biological oceanography and added to the number of biological oceanographers determined from the apportionment of the total number who actually did check the "oceanography" box of the questionnaire. Once this was done, the total in each subfield was estimated and a percentage of the total number of respondents was recorded. These percentages were used as a crude estimate of the subfield breakout at the Ph.D. crude estimate of the subfield breakout at the Ph.D. level and are presented in Data Appendix B, Table B.4 and displayed in Figure 18.

B. BIENNIAL SURVEY (of Doctorate Recipients)

1. General Overview

The NRC *Survey of Doctorate Recipients* (referred to in this report as the Biennial Survey) is conducted by the National Research Council with the support of the National Science Foundation, the National Endowment for Humanities, and the National Institutes of Health. The Biennial Survey is concerned primarily with the employment status and characteristics of individuals in the United States who have earned doctorates in science, engineering, and the humanities. The Biennial Survey has been conducted since 1973, and data are available for most employment variables for the years 1973, 1975, and 1977. The population sampled includes:

(a) Individuals recorded in the Annual Census who earned doctorates in science, engineering, or the humanities (individuals are excluded who were foreign citizens or who, at the time they received their degree, indicated plans to leave the United States);

(b) Individuals recorded in the Annual Census who earned doctoral degrees in education or professional fields, who were known afterward to be employed as scientists or engineers; and

(c) Individuals who earned foreign doctorates and were known afterward to be employed as scientists or engineers in the United States.*

Only a fraction of the sample frame is surveyed with the number of individuals questioned determined by the population size of various strata. Once selected, the same individuals are included in each survey with the following exceptions. For each Biennial Survey, a sample is added from the two most recent year's degree recipients, and the two oldest cohorts are dropped. In addition, individuals are excluded from the active sample and not surveyed if they are known through a previous survey or address search to be deceased; foreign citizens who earned their doctorates from foreign institutions and are residing outside of the United States; or recipients in nonscience/nonengineering fields. Population estimates are determined by weighting the responses by strata. The fine fields of oceanography and marine science/other are included in the broad field of earth, environmental, marine sciences, which in turn, for some summary purposes, is included in the biennial group of the physical sciences.

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*In the 1973, 1975, and 1977 surveys, individuals in segment (b) were identified from the NSF National Register of Scientific Personnel (1968-1970), the Engineer Register (1967-1969), or the Employment Survey (1971). Individuals in segment (c) were identified from a number of sources including the NSF's National Register of Scientific and Technical Personnel, *American Men and Women of Science*, federal laboratories, selected large industrial companies, and catalog of doctorate-granting universities. After the 1973 survey, only a few additions to segments (b) and (c) have been made to the sample for the 1975 and 1977 surveys. The Annual Census has been the principal source for updating the sampling frame.

A doctoral oceanography-employed scientist (DOS) or a oceanography-trained doctoral scientists (ODS) in this data set is anyone who checked the oceanography or marine science/other boxes for their field of employment or field of Ph.D. degree.

The Biennial Survey is probably the best overall and comprehensive information source we have on doctoral ocean scientists. However, the precision of the population estimates is low because the sample is not selected by fine fields. Thus, the total number sampled can be marginally small for oceanography and other fine fields. Instead, sampling is done so that information on the broad fields, for example, earth sciences, will be acceptably accurate.

The categories in the Biennial Survey are similar to those in the Annual Census;

All sciences,
 Broad fields (e.g., physics/astronomy), and
  Fine fields (e.g., oceanography).

Groupings within categories were somewhat different between the Annual Census and the Biennial Survey. For example, the fine field marine science/other is included under the earth sciences field in the Biennial Survey. However, the Annual Census did not have a marine science/other fine field until 1978. Thus, care should be taken when comparing the Census and Survey by field specialties.

The data from the Biennial Survey include postdoctoral appointees except when looking at primary work activity and type of employer.

For our study, we considered the Biennial Survey fine fields of oceanography and marine science/other as one category because this combination is a better approximation of the population sampled by the *Directory* data.

Data were received for all information presented in the Survey's 1977 report. The fine fields oceanography and marine science/other category were deleted from the earth sciences field category and tabulated separately. Thus, information was obtained for oceanography and marine science/other for comparison with all other science fields including the other "earth" sciences.

Since 1975, the Biennial Survey has not added individuals to its sample who earned foreign Ph.D. degrees. Therefore, the data on such individuals employed in the United States are underestimated.

Academic employers include 4-year and 2-year institutions and medical schools.

2. Sampling Procedure and Survey Design

The following paragraphs summarize the sampling procedure and survey design used by the Biennial Survey in the collection of data on doctorate recipients.

All data reported by the Biennial Survey are estimates of the population based on sample observations. Like all such estimates, they are subject to sampling error, which is a measure of the precision with which an estimate based on the survey sample approximates the average results of all possible samples of equal size and same design.

Table percentages represent the ratio of two random variables. The sampling error of ratio estimate is computed by the formulas on pages

76 and 77 of the 1977 NRC report *Science, Engineering, and Humanities Doctorates in the United States* (reproduced below). The 90 percent confidence interval is that 90 percent of such intervals (constructed from samples of equal size and same design) will contain the true (population) value being estimated.

The Biennial Survey sample is randomly selected by strata, which are defined by the categories of five variables: field, year of doctorate, sex, type of degree (U.S. science/engineering, U.S. nonscience/nonengineering, and foreign), and race (for individuals receiving degrees in fiscal year 1973 and after). Strata are sampled at variable rates ranging from 7 percent for very large population subgroups to as much as 100 percent when required to obtain a sufficient number of sample cases to make estimates for certain very small population subgroups (such as women or minorities). Oceanographers and marine scientists are sampled from strata defined by the field category earth sciences. Because oceanography and marine sciences constitute only a part of the large stratifying category (earth sciences), the number of oceanography cases in the sample tends to be small and, for certain estimates, below that which would have been selected had these fields been the primary sampling category.

Only the weighted figures are reported in the Appendix B Data Tables. The weighted number is obtained by multiplying the sample observations by a population weight, which is the product of the inverse of the sampling rate and an adjustment for nonresponse. For example, given a strata of 100 individuals, 50 of whom were selected for the sample, 40 of whom responded to the survey, and 10 of whom reported holding a doctorate in oceanography, the population estimate would be obtained by multiplying the 10 oceanography respondents by 100/50 or 2 the inverse sampling rate) and 50/40 or 1.25 (the adjustment for nonresponse). This would yield an estimate of 10 x 2 x 1.25 = 25.

The small number of oceanographers and marine scientists in the sample necessarily results in relatively large sampling errors. For example, of the estimated 1533 Ph.D.'s employed as oceanographers or marine scientists in 1977, 61.3 percent were estimated to be working at colleges or universities. Using the procedure described on pages 77-88, the sampling error can be approximated by:

$$sp = \left[\frac{0.613(1 - 0.613)}{200}\right]^{\frac{1}{2}} = 0.034 \text{ or } 3.4 \text{ percent.}$$

Obviously, estimates based on fewer sample observations would be subject to greater error. In general, if the sample, *N*, is reduced to 1/4*N*, the error will double (i.e., the error associated with an estimate of 61.3 percent based on 50 observations would approximately equal 6.8 percent). Alternatively, as estimates approach extreme values (e.g., 1, 5, 95, or 99 percent), the estimated variance (and hence the sampling error) is reduced, given the same sample size. For example, it is reported that 4.1 percent of the oceanographers/marine scientists were employed by state or local governments in 1977. The approximate sampling error would equal

$$\left[\frac{0.041(1 - 0.041)}{200}\right]^{1/2} = 0.14 \text{ (1.4 percent).}$$

In order to assess the precision of reported statistics, the reader is cautioned to pay particular attention to the sampling error and the confidence interval associated with any estimate based on a small number of sample observations.

Finally, all data derived from survey research are subject to certain nonsampling errors. Misinterpretation of questions, errors in coding and processing of the data, and incomplete coverage of the sample (nonresponse data) can all affect estimates of the population.

3. Sampling Error Estimates for Ratios*

Most of the statistics presented in this report are ratios of two weighted sums of observations, i.e., ratios of randon variables. Thus, for example, we are concerned with a ratio, $r = y/x$, where

$$y = \sum_h \left[N_h/n_h\right] \sum_i y_{hi}$$

$$x = \sum_h \left[N_h/n_h\right] \sum_i x_{hi}$$

and where y_{hi} and x_{hi} are observations made on the i^{th} response of stratum h, N_h is the number of individuals in the active population of stratum h, and n_h is the number of responses from stratum h.

The estimates of sampling error in this report are computed as if the responses obtained for a stratum are a random sample from that stratum. Strata were combined whenever the number of responses in a stratum was less than two.

The variance of the ratio y/x is estimated by the expression

$$s_r^2 = \left(\frac{y}{x}\right)^2 \left(\frac{s_y^2}{y^2} + \frac{s_x^2}{x^2} - \frac{2s_{xy}}{xy}\right)$$

where

$$s_{xy} = \sum_h \frac{N_h^2}{n_h} \frac{N_h - n_h}{N_h - 1} \frac{1}{n_h - 1} \left(\sum_i \left[x_{hi} - \bar{x}_h\right]\left[y_{hi} - \bar{y}_h\right]\right).$$

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*Reproduced directly from *Science, Engineering and Humanities Doctorates in the United States, 1977 Profile*, Commission on Human Resources, National Research Council (National Academy of Sciences, Washington, D.C., 1978), pp. 76-80.

$\bar{x}_h$ and $\bar{y}_h$ being the means of the x and y values observed in stratum h, respectively. Similarly, s_x^2 and s_y^2 are defined using $\left[x_{hi} - \bar{x}_h\right]^2$ and $\left[y_{hi} - \bar{y}_h\right]^2$ in the inner summation.

Some of the statistics in the report are differences between two estimated ratios in percentage form, e.g., the difference between the percentage of engineers employed by business or industry in 1977 and the corresponding percentage for 1975. If we write the difference as

$$r_1 - r_2 = \frac{y_1}{x_1} - \frac{y_2}{x_2} ,$$

the variance is estimated by

$$s^2_{r_1 - r_2} = s^2_{r_1} + s^2_{r_2} - 2s_{r_1 r_2} .$$

The terms $s^2_{r_1}$ and $s^2_{r_2}$ are estimated variances of ratios, calculated as given above, and $s_{r_1 r_2}$ is estimated by

$$s_{r_1 r_2} = r_1 r_2 \left(\frac{s_{y_1 y_2}}{y_1 y_2} + \frac{s_{x_1 x_2}}{x_1 x_2} - \frac{s_{x_1 y_2}}{x_1 y_2} - \frac{s_{x_2 y_1}}{x_2 y_1} \right)$$

where, for example,

$$s_{y_1 y_2} = \sum_h \hat{n}_h \frac{N_{1h} N_{2h}}{n_{1h} n_{2h}} \frac{1}{\hat{n}_h - 1} \left(\sum_i \left[y_{1hi} - \bar{y}_{1h}\right] \left[y_{2hi} - \bar{y}_{2h}\right] \right)$$

and the other covariances are written in similar fashion. In these expressions, $\hat{n}_h$ is the number of responses in stratum h that are common to the estimates y_1 and y_2; thus, strata may be combined as necessary to ensure that $\hat{n}_h$ is greater than one.

The standard errors presented in the text are the square roots of the variances described above.

Comparisons can be made between sampling errors computed on the basis of a simple random sample (srs) and those which take into account stratification. Table E.1 presents sampling errors associated with selected statistics from the report. Bases of various sample sizes and a range of statistic values

TABLE E.1 Comparison of Sampling Errors for Selected Statistics

Variable Base and Subcategory	Sample Size of Variable Base	Statistic (%)	s_p (%) (srs)	s_r (%) (Stratified)
1. Science/Engineering				
Field of Ph.D.--Total Engineering Ph.D.	37,488	15.0	0.2	0.1
Field of Employment--Total Employed Employed in Mathematics	34,599	4.7	0.1	0.1
Physics/Astronomy Ph.D.--Total Employed Employed in Physics/Astronomy	3,097	61.8	0.9	0.9
Biological Science Ph.D.--Total Female	8,895	16.9	0.4	0.1
Earth Science Ph.D.--Total Employed Part-Time	1,382	2.0	0.4	0.4
Computer Science Ph.D.--Total Full- or Part-Time Employed Employed in Business or Industry	636	53.9	2.0	2.1
Chemistry Ph.D. (FY 1971-1976 Graduates)--Total Full- or Part-Time Employed Employed in Teaching	992	22.6	1.3	1.4
1960-1969 Ph.D. Recipients (Male)--Total Academically Employed Hold Rank of Professor	6,364	42.8	0.6	0.6
Labor Force--Total Unemployed, Seeking Employment	35,115	1.2	0.1	0.1
Labor Force--Total Social Science Ph.D. Employed Full-Time	4,366	94.3	0.4	0.4
Labor Force--Total Male Unemployed, Seeking Employment	28,199	0.9	0.1	0.1
Labor Force--Medical Science Ph.D./Female Employed Full-Time	304	79.6	2.3	2.3
2. Humanities/Selected Social Sciences				
Field of Ph.D.--Total History Ph.D.	10,276	21.8	0.4	0.1
Field of Employment--Total Employed Employed in Music	9,048	4.4	0.2	0.1
History Ph.D.--Total Employed Employed in Social Sciences	1,550	3.3	0.5	0.5
Philosophy Ph.D.--Total Female	682	13.5	1.3	0.4
Modern Language Ph.D.--Total Employed Full-Time	2,191	78.6	0.9	0.8
Art History Ph.D.--Total Full- or Part-Time Employed Employed in 4-Year College/University	315	88.3	1.8	2.0
Speech Ph.D. (FY 1971-1976 Graduates)--Total Full- or Part-Time Employed Employed in Management/Administration	108	6.1	2.3	2.7
1950-1959 Ph.D. Recipients (Male)--Total Academically Employed Hold Rank of Professor	928	87.0	1.1	1.1
Labor Force--Total Unemployed, Seeking Employment	9,366	2.9	0.2	0.2
Labor Force--Total Music Ph.D. Employed Full-Time	548	90.3	1.3	1.2
Labor Force--Classical Languages and Literature Ph.D., Male Employed Full-Time	211	94.3	1.6	1.6
Labor Force--Total Female Unemployed, Seeking Employment	3,025	6.8	0.5	0.5

have been chosen to provide representative comparisons. Sampling errors in the column s_p were computed with the expression $\left(\frac{p[1-p]}{n}\right)^{\frac{1}{2}}$, while those under s_r were calculated with the formula described above, which takes into account the sample design. The statistics are in percentage form and are the estimated proportion of a variable category with a given characteristic, $\frac{1}{n}\sum_{i}^{n} y_i$ (for the purposes of s_p), or the ratio of two random variables, $\frac{y}{x}$ (for the purposes of s_r).

For the most part, differences between the two error estimates are small. Calculations based on an srs are for most statistics the same as or slightly higher than those which take account of the stratification. For statistics which are ratios of two stratifying variables (e.g., the ratio of women philosophy Ph.D.'s to total philosophy Ph.D.'s), the estimate of sampling error is much higher using the formula for s_p. In certain cases (mainly those involving estimates of type of employer or primary work activity for small subgroups), the use of the formula for an srs appears to underestimate the sampling error.

Taking these potential discrepancies into account, a useful approximation of the sampling errors of those statistics presented in this report in percentage form can be obtained from Table E.2. This table summarizes sampling errors associated with various proportion values at given sample sizes. Calculations in the table assume a simple random sample.

TABLE E.2 Approximate Sampling Errors for Various Statistics and Sample Sizes

Sample Size	Proportion				
	0.01 or 0.99	0.05 or 0.95	0.10 or 0.90	0.25 or 0.75	0.50
37,500	0.00051	0.00113	0.00155	0.00224	0.00258
12,100	0.00090	0.00198	0.00273	0.00394	0.00455
10,300	0.00098	0.00215	0.00296	0.00427	0.00493
9,000	0.00105	0.00230	0.00316	0.00456	0.00527
4,300	0.00152	0.00332	0.00457	0.00660	0.00762
2,400	0.00203	0.00445	0.00612	0.00884	0.01021
1,200	0.00287	0.00629	0.00866	0.01250	0.01443
800	0.00352	0.00771	0.01061	0.01531	0.01768
400	0.00497	0.01090	0.01500	0.02165	0.02500
200	0.00704	0.01541	0.02121	0.03062	0.03536
100	0.00995	0.02179	0.03000	0.04330	0.05000

Values for Table E.2 were computed using the formula $s_p = \left(\frac{p[1-p]}{n}\right)^{\frac{1}{2}}$, in which p is the proportion of a particular category (variable) possessing a certain characteristic, y $\left(\text{i.e.,}\quad p = \frac{1}{n}\sum_{i}^{n} y_i\right)$, and n is the number of sample cases in the variable-specified category (e.g., doctoral scientists and engineers in the U.S. labor force). The finite population correction factor, $\text{fpc} = \left([N-n] \,/\, [N-1]\right)^{\frac{1}{2}}$, has been omitted from the calculations, since the fpc has negligible effect on most statistics in this report, unless the estimate applies to a subgroup that has a high sampling rate. In any case, the omission of the fpc in the formula for s_p yields a conservative estimate (i.e., a higher estimate) of the sampling error.

The estimated populations for particular variables are provided in this report. The sample sizes can be estimated by multiplying the population by the weighting fraction, which is the sampling fraction corrected for non-response. The mean weighting fractions for selected groups are:

	Science/ Engineering	Humanities/Selected Social Sciences
TOTAL IN U.S.	0.127	0.130
Men	0.112	0.111
Women	0.254	0.198
Minority Racial Group	0.166	0.300

Example: In Table 1.5A, the total employed population of doctoral scientists and engineers is 267,206. Multiplying by 0.127, the approximate sample size is 33,935. The sampling error of a reported statistic (for instance, employed in business or industry, 26.4 percent) can be estimated using the formula for s_p or consulting Table E.2 using rough approximations of the sample size and percentage in proportion form. In this case, $s_p = \left(\frac{0.264 \cdot [1-0.264]}{33{,}935}\right)^{\frac{1}{2}} = 0.00239$, or 0.2 percent. Similarly, the value in the table opposite 37,500 for 0.25 is 0.00224. The reader can construct the desired confidence interval by multiplying the standard error by the appropriate coefficient: ±1 s_p will provide a 66.7 percent confidence interval, ±2 s_p approximately a 95 percent interval, etc.

C. U.S. DIRECTORY OF MARINE SCIENTISTS

1. General Processes and Overview

The *U.S. Directory of Marine Scientists* (referred to in this report as the *Directory* or the DMS) is prepared under the auspices of the Ocean Sciences Board of the NRC and its predecessors. Three forms of the "directory" should be recognized. They are (a) the 1975 edition of the *U.S. Directory of Marine Scientists*, (b) the set of data from the questionnaire circulated in 1974 to obtain information for the 1975 directory and supplemented by data from about 1000 more questionnaires obtained in 1976, and (c) the data from (b) "filtered" by the panel to include only oceanographers (as defined by the panel) who have Ph.D. degrees.

In the DMS, the definition of an oceanographer is: an ocean/marine scientist who filled out a questionnaire distributed by the Ocean Sciences Board in 1974 or 1976. Most individuals listed in the *Directory* would be considered by this study as "oceanographers." However, some individuals would not have checked the oceanography or the marine science/other box if presented with the Biennial Survey or the Annual Census questionnaire. An attempt was made to identify (and for comparative purposes to set aside data on) such individuals in order to make the *Directory* data more comparable with the Biennial Survey and the Annual Census data.

The *Directory* information allows us to compile data on the number of doctoral ocean scientists by field and subfield of employment, their Ph.D. institutions, their geographic distribution, their employment sector distribution, and employed oceanography Ph.D. equivalents by subfield. A Ph.D. equivalent was defined as one who (1) shows evidence of research productivity, e.g., several senior-authored papers in a scientific journal, or (2) participated in a recognized administrative or educational ocean science activity for five or more years at levels of professional responsibility and achievement equivalent to an assistant professor, head of a laboratory or department, or a government employee with a GS rating of 13 or higher.

The *Directory* is a reasonably comprehensive survey of individuals who were working in oceanography in the various employment sectors (academia, government laboratories) at the time the material was collected (1974-1975). However, the *Directory* is weak in its coverage of oceanographers in industry because no special attempt was made to sample the business/industry sector.

Approximately 3000 individuals are listed in the published *1975 U.S. Directory of Marine Scientists*. Another 1000 names were added when the directory data set was updated in 1976. The combined data were used for this study.

The directory data were edited so that

(a) The identification of degree-granting institutions is internally consistent and coded according to the standard NAS numerical institution code;

(b) All references to degrees granted at the Ph.D. level are internally consistent;

(c) Individuals can be identified as having Ph.D. degrees, being equivalent to Ph.D.'s, or other; and

(d) All Ph.D. holders and Ph.D. equivalents have been assigned to one of the following major fields of research activity: physical oceanography, biological oceanography (including fisheries oceanography), chemical oceanography, geology/geophysics, engineering, or other.

Tables have been obtained specifying numbers of individuals receiving the Ph.D. degree by institution per year from 1958 through 1976.

Hand counts of the numbers of individuals at various laboratories in the published directory were made, consolidated into regional groups, and tabulated.

2. Compatibility with Other Data Sets

Each data set studied for this report involves a different population of oceanographers. Because of major differences in the total number of Ph.D.'s reported by the Annual Census and the number reported in the *Directory*, an attempt was made to determine how the *Directory* data might be filtered in order to eliminate individuals who, if confronted with an Annual Census questionnaire, would have checked some box other than the "oceanography" or "marine science/other" box as their field of specialization.

First, the original 1974 directory questionnaire was sent to panel members who identified "positive" items in the questionnaire that would probably have been checked by an "oceanographer" responding to the Annual Census questionnaire and "negative" items that are strong indicators that an individual would not have checked the oceanography box in the Annual Census questionnaire. There was a high level of agreement in their responses. Individuals who checked one or more of the positive items were included in the tabulations for this study.

In another attempt to trace the differences in the total numbers of Ph.D.'s in the *Directory* and the Annual Census, printouts of all individuals listed in the *Directory* who received degrees at 12 degree-granting institutions were sent directly to each institution with a request that each individual listed be identified as having received an "oceanography" Ph.D. degree or some other doctoral degree. All 12 institutions responded. These data are reported in Table 5. In most cases, the replies clearly indicate that the larger number of Ph.D.'s reported by the *Directory* is because individuals are included in the *Directory* who did not receive an "oceanography" degree.

3. Ph.D. Equivalents

The *Directory* data set was reviewed in detail by the panel in order to identify Ph.D. equivalents. First, the individual data sheets for individuals who did not report that they had received a Ph.D. degree were obtained. These were then sorted into five sets and marked (tentatively) as being in the fields of biological oceanography, chemical oceanography, geology/geophysics, physical oceanography, or ocean engineering. These five sets of individual data sheets were then sent to panel members Alexander, Goldberg, Byrne, Robinson, and Kohler, respectively. They were asked to verify the field identification and decide whether each individual was a Ph.D. equivalent.

Unfortunately, the data sheets did not contain information that was compatible with the test for "equivalency" proposed by the panel. Lacking such information, panel members relied on (1) evidence of publication, (2) indications of seniority of position or rank by title of position held, (3) inferences of duration of employment from titles of positions held, and (4) indication that the individual had a master's degree and had published recently. Finally, knowledge about the institution at which the individual was employed was used to upgrade or discount the weight given to titles and evidence of publications.

The 265 Ph.D. equivalents identified are not included in the tabulations for this report. Of these, 143 (more than half) received their highest degree before 1958. Their subfields were biology, 43 percent; physics, 31 percent; geology/geophysics, 12 percent, and chemistry, 4 percent.

Individuals with Ph.D. degrees were sorted and ranked by the five categories without being checked by panel members because of the high level of concurrence in Vetter's assessment for the Ph.D. equivalent groups.

With these assessments of each individual data sheet made, each data record was adjusted, and the tabulations presented in Tables B.29, B.30, and B.31 were prepared.

D. Other Data Sets

The *University Curricula in Marine Sciences and Related Fields* (UCMS) is published under the auspices of the Office of Sea Grant, NOAA, Department of Commerce. The 1976 edition, listing 154 colleges and universities and 11 laboratories, and consortia, was used as background for this report. The 1979 edition's information on doctorate oceanographers is essentially the same as that in the 1976 edition. The UCMS editions do not contain useful information on the production of Ph.D.'s. Only 12 of 154 institutions listed the number of oceanography Ph.D.'s graduated. Most of the information in the 1976 edition was obtained in 1975. Furthermore, it appears that many institutions did not update information provided in the previous edition.

The primary purpose of the UCMS is to provide a guide to current courses of study offered by U.S. universities, colleges, and technical institutes. The criterion for inclusion is a program of at least 25 semester hours in the marine field. Programs in the marine sciences can lead to a Ph.D. degree, a BS/MS degree, an AS/AA degree, or a baccalaureate minor.

Institutions are listed alphabetically, and the information provided is usually organized as follows: facilities available, including research laboratories and vessels; degree programs in the marine field; courses offered; names of the marine faculty; and the name of a person to contact for further information.

Some of the institutions whose curricula appeared in the pre-1976 edition either did not respond to the questionnaire or their response was received too late and/or in a format that could not readily be utilized. In these cases, rather than no inclusion at all, the pre-1976 information was repeated. Fourteen schools were chosen at random to check the quality of the updating. Nine had sent in updated curricula, two had not. One listed in the recent but not the previous edition; two were not in the recent edition but were in the previous one.

Curricula in the Atmospheric and Oceanographic Sciences (CAOS) is a biennial report published by the American Meteorological Society. The oceanographic content is essentially limited to physical oceanography and some meteorology degree programs that include oceanography courses.

The qualification for inclusion is that the course of study lead to a graduate or undergraduate major in meteorology or oceanography or closely related disciplines. The 1978 edition lists 86 U.S. institutions, the names of teaching and research staff, degrees offered (usually with degree titles), courses offered and the number of Ph.D. degrees awarded in the last two academic years. Fourteen institutions reported Ph.D. oceanography programs.

Data from the CAOS were not incorporated in this report.

For both of the UCMS and the CAOS sources the definition of a Ph.D. oceanography curricula has two controls: (1) it has been defined as leading to a Ph.D. degree in oceanography by the institutions responding, and (2) it has met the criterion for inclusion established by the compilers of the reports. Some questions that can be answered by these two data sources are: how many institutions offer what kinds of degrees by department name, degree title, and specializations offered; the character of the various degree programs; the outside laboratory, consortia affiliations of the various institutions; and the instructors available.

The *University of Connecticut Survey of Marine Scientists* was conducted in 1977 by the Social Science Data Center of the University of Connecticut with the support from the Office of Sea Grant, NOAA, of the U.S. Department of Commerce. The major purposes of the survey were to assess the effects of federal funding on academic marine scientists, in particular, via their perceptions of federal programs, and to assess the educational and employment opportunities of recent marine-trained graduates. The survey reviewed the marine programs of 52 U.S. universities and colleges, including (a) all UNOLS institutions; (b) other Sea Grant institutions; (c) other major schools not included in (a) or (b); and (d) 12 smaller curricula schools randomly selected from UCMS.

The survey broadly defined a marine scientist as anyone who spends at least a third of his or her time working in the marine science field and, in addition, marine scientists who work in the classical fields of biology, chemistry, physical sciences, and geology/geophysics. The survey included individuals who work in the areas of ocean or marine engineering, fisheries, resource development and management, and marine affairs.

A Faculty Survey and an Alumni Survey were conducted. The Faculty Survey included professional research personnel and administrators of academic marine programs and laboratories at the 52 institutions for a total of about 2100 individuals of whom 1800 were randomly selected and mailed questionnaires. Approximately 800 individuals who qualify as marine scientists responded to the questionnaire for a response rate of 54 percent. The Alumni Survey included recent marine science graduates (1971-1976) from the 52 institutions, for a total of about 1500 individuals. A census was made of these graduates, with a response rate of 60 percent.

The Faculty Survey is a good survey of academic oceanographers, i.e., it was designed to show significant statistical information concerning this one area of the oceanographic community. However, it does not contain any information on oceanographers in government or business/industry.

The Alumni Survey is a good overall study of directly trained Ph.D.'s but for recent years only (1971-1976).

Preliminary data from these two surveys were reviewed during the preparation of this report but were not used.

E. INDUSTRY QUESTIONNAIRE

In the fall of 1978, when it was recognized that the *U.S. Directory of Marine Scientists* data had missed a large number of Ph.D.'s employed by industry, a questionnaire was sent to approximately 100 industrial firms asking for information on their employment of Ph.D. oceanographers. Of the 55 responses, 38 indicated some employment of Ph.D. oceanographers.

The definition of an oceanographer presented was "a person whose one-line job description necessarily includes the word oceanography or an equivalent." For example "conducts biological studies of effects of municipal sewage dumping," or "undertakes geological/geophysical oceanographic recognizance of prospective oil drilling sites." Unfortunately (perhaps predictably) the responder's interpretations of this definition of an "oceanographer" were highly variable. For example, one oil company employing large numbers of scientists for offshore geophysical prospecting reported more than 100 oceanography Ph.D.'s as employed, while others, equally active, reported much smaller numbers and in one case none. However, allowing for differences in interpretation and number of industrial organizations missed by this survey, the panel concluded that the data received substantiated the data from the NRC Biennial Survey that approximately 10 percent of U.S. doctoral ocean scientists were employed by industry in 1977.

The questionnaire also asked for information about trends in employment. These data indicated an approximate linear increase from 1961 through 1977, an abrupt increase in 1978, and a conservative, essentially uniform, increase thereafter to 1990. Because the 1978 data were then current and no rationale was apparent for the abrupt 1977-1978 increase, these data can only be interpretated as indicating that employment of Ph.D. oceanographers by industry has been increasing.

In summary, the industry questionnaire substantiates the 10 percent estimate in the NRC Biennial Survey and indicates that more oceanographers are being employed by industry.

F. PRE-1958 DOS SUBPOPULATION ESTIMATES

The following outlines the steps taken to obtain the pre-1958 estimates for the subpopulations of doctoral ocean scientists displayed in Table 1.

Given:

(1) Number of Pre-1958 DOS - 389 (from *Directory* data).

(2) ODS = ODOS + ADOS = ODOS + AD_oOS + AD_aOS.

(3) ODOS/ODS = 0.7 (from Biennial Survey data, see Figure 10. Perhaps 0.8 or 0.9 could have been used. However, the number of pre-1958 individuals sampled by the Biennial Survey is so small that it was considered better to use the total overall ratio for all years. Even if 0.9 were used, only 9 more ODS would have been added).

Assume:

(4) AD_oOS/ODOS = 4.5 (from Biennial Survey data, see Figure 11).

(5) AD_aOS/DOS = 0.6 (from post-1958 trends, see Figure A.1).

Then:

(6) From (5): AD_aOS = 0.6 DOS = 0.6 x 389 = 233.4 (round to 233).

(7) From (1): ODOS + AD_aOS = DOS - AD_aOS = 389 - 233 = 156.

(8) From (4) and (7): AD_oOS = 4.5 ODOS,
and ODOS + AD_oOS = 156,
ODOS + 4.5 ODOS = 156,
5.5 ODOS = 156,
ODOS = 156/5.5 = 28.4 (round to 28).

(9) From (4): AD_oOS = 4.5 ODOS = 4.5 x 28.4 = 127.6 (round to 128).

Check: DOS = ODOS (28) + AD_oOS (128) + AD_aOS (233) = 389.
Next: From (3): ODS = ODOS/0.7 = 28.4/0.7 = 40.6 (round to 41).
Thus: ODAS = ODS (41) - ODOS = (28) = 13.

G. RECENT CHEMICAL, GEOLOGICAL/GEOPHYSICAL, BIOLOGICAL, AND PHYSICAL OCEANOGRAPHY-TRAINED DOCTORAL SCIENTISTS

During the preparation of this report, the conclusion (illustrated by Figure 21) that about as many chemical oceanography as marine geological/geophysical Ph.D. degrees had been granted during the mid-1970's was questioned. In order to obtain independent data on this matter, the ten institutions producing the most oceanography Ph.D.'s in 1977 were queried to determine the number of their Ph.D. graduates in 1977-1979 and the number of Ph.D. candidates expected to graduate during 1980-1982 in chemical, geological/geophysical, biological, and physical oceanography. Table A.1 consolidates the replies of the eight institutions with "open" ocean programs (Scripps Institution of Oceanography), University of Rhode Island, Oregon State University, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution, Texas A&M

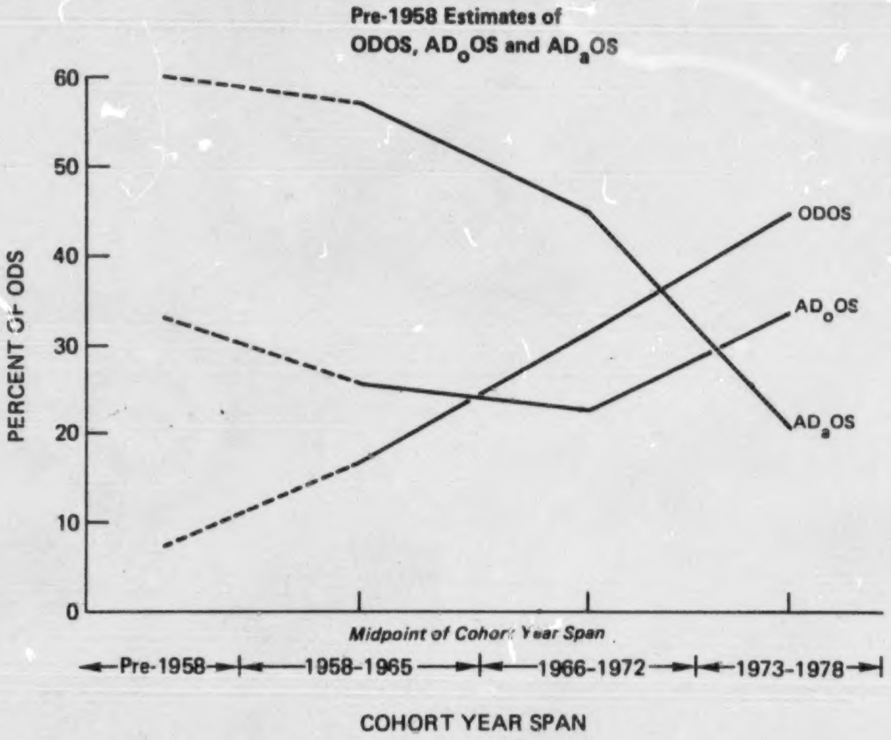

FIGURE A.1 Pre-1978 estimates of Oceanography-Trained Oceanography-Employed Doctoral Scientists (ODOS) and Alternately Trained Oceanography-Employed Doctoral Scientists who perceive themselves to be oceanographers (AD_oOS) and who perceive themselves to be alternate scientists (AD_aOS).

University, University of Miami, University of Washington, and University of Hawaii) and the two without (William and Mary/Virginia Institute of Marine Science and Florida State University). Although the sample size of the later group is regretably small, it seems clear that institutions associated with "open" ocean programs produce about twice as many geological/geophysical as chemical oceanography Ph.D.'s and that institutions with "coastal" ocean programs produce many times as many chemical as geological/geophysical Ph.D.'s. Because there are several times as many "coastal" as "open" ocean oceanography Ph.D.-granting institutions, we conclude that the data illustrated in Figure 21 are reliable.

TABLE A.1 Oceanography Ph.D. Graduates and Candidates by Field and Type of Program

	Graduates 1977-1979		Candidates 1980-1982		
	No.	%	No.	%	Increase %
"Open" Ocean Programs					
Chemical	35	11	74	14	111
Geological/Geophysical	72	24	174	33	142
Biological	102	33	137	26	34
Physical	69	23	81	16	173
(Subtotal)	(278)	(91)	(466)	(89)	68
"Coastal" Ocean Programs					
Chemical	9	3	21	4	133
Geological/Geophysical	0	0	1	0	--
Biological	15	5	25	5	60
Physical	4	1	11	2	175
(Subtotal)	(28)	(9)	(57)	(11)	104
TOTAL	306	100	523	100	71

H. CLASSIFICATION OF BIOLOGICAL OCEANOGRAPHY

The classification of a scientists trained as a biological oceanographer presents some difficulty, because in some cases this could include individuals who may well be marine biologists rather than oceanographers. On the other hand, it is more likely perhaps to exclude marine biologists, and thus persons with ocean science degrees trained in biology but not associated with an oceanographic institution could ultimately be listed as ADOS, simply because their degree is not in oceanography. In such cases, although they would appear to be recruited into the ocean sciences from other fields, this is not strictly true, and the apparent field mobility may not reflect a real trend, at least not in its entirety. No distinction is made in the report between "biological oceanographer" and "marine biologist" or between the subfields of biology, since such distinctions are not inherent in the data sets. This need not be considered a serious problem as long as it is recognized. This could provide an explanation for the high percentage of oceanographers with degrees in the life sciences (51 percent) and also why half of the practicing ocean doctoral scientists are in biological oceanography. Furthermore, biological oceanography also includes a group of scientists closely allied to but distinct from fisheries scientists--the fishery oceanographers. This is a relatively new distinction but one that will be more evident in the future. These individuals are probably lumped into the biological oceanographers now or may fall outside the individuals considered in this report.

The biological area of the ocean sciences, then, includes a broad range of related areas that spread into nonspecifically ocean fields, probably to a greater degree than is true for other fields of oceanography.

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SURVEY OF EARNED DOCTORATES
AWARDED IN
THE UNITED STATES

Conducted by
The National Research Council
in Cooperation with
The American Council of Learned Societies,
The Social Science Research Council, and
The Graduate Deans

Supported by
The National Science Foundation,
The U.S. Office of Education,
The National Endowment for the Humanities, and
The National Institutes of Health

To the Doctoral Candidate:

This is a brief description of the Survey of Earned Doctorates indicating how the resulting data are used and the individual confidentiality of data is protected. The basic purpose of this Survey is to gather objective data about doctoral graduates, data that are often helpful in improving graduate education. We ask your cooperation with the project.

The information requested on the accompanying questionnaire is largely self-explanatory. Please complete it, detach it along the perforated line, and return it to your Graduate Dean. On the back of this sheet is a Specialties List with code numbers and titles for classifying your fields of specialization. This will be useful in connection with several items on the questionnaire. If none of the detailed fields listed seems to be appropriate, note the "General" and "Other" categories.

What is the Survey of Earned Doctorates?

The Survey is conducted annually by the Commission on Human Resources of the National Research Council in cooperation with the American Council of Learned Societies and the Social Science Research Council. The form is distributed with the cooperation of the Graduate Deans and filled out by all graduates who have completed requirements for their doctoral degrees. Research doctorates in all fields are included, but professional degrees such as the MD, DDS, and DVM are not included because information about recipients of those degrees is compiled elsewhere. The cumulative file goes back to 1920 and is called the Doctorate Records File.

The use of the doctoral data has been increasing, partly because of the implications for graduate education stemming from the change in the growth pattern of the number of persons receiving doctorates (562 in 1920; 3,278 in 1940; 9,735 in 1960; 29,497 in 1970; peaking at 33,727 in 1973; and now at 30,850 in 1978). This survey attempts to supply some of the information as of the time the doctorate is received.

What uses are made of the Survey data?

The data collected by this survey questionnaire become part of the Doctorate Records File maintained by the Commission on Human Resources of the National Research Council. The Survey data are collected with the intention that they will be put to use, but only under carefully defined conditions. Such data as the number of degrees awarded in each field of specialization, the educational preparation of degree recipients, their sources of financial support, the length of time required to attain the degree, and postdoctoral employment plans of doctorate recipients are of great interest to graduate schools, employers, the scholarly community, and the nation generally. The Doctorate Records File is used for a limited number of carefully defined follow-up research studies. Each year a sample of doctorate recipients is selected for inclusion in a longitudinal research file maintained for the National Science Foundation, the National Institutes of Health, and the National Endowment for the Humanities.

Statistical summaries from the Doctorate Records File are used by educational institutions, professional societies, and government agencies. Some specific examples are:

- An extensive statistical summary of the data is published and distributed to all graduate schools about every five years.(1) These reports have been widely used by graduate schools and states to evaluate their progress in providing doctoral education. The data may also be useful to graduate students as an aid in selecting a graduate department.
- Annual reports containing statistical summaries based on the most recent year's Survey are distributed to graduate schools, government agencies, and any others on request.(2)

The confidentiality of Survey data is carefully protected.

This information is solicited under the authority of the National Science Foundation Act of 1950, as amended. All information you provide will be treated as confidential and will be used for statistical purposes only. Information will be released only in the form of statistical summaries or in a form which does not identify information about any particular person. There are only two exceptions to this policy: (1) information (name, year, and field of degree) is released to institutions from which you received degrees and to other organizations as part of the address search procedure for follow-up research studies; and (2) information from your form will be made available to the institution where you receive your doctoral degree. Your response is entirely voluntary and your failure to provide some or all of the information will in no way adversely affect you.

(1) National Academy of Sciences, *A Century of Doctorates — Data Analyses of Growth and Change*, Washington, D.C. 1978.
(2) National Academy of Sciences, *Summary Report 1978, Doctorate Recipients from United States Universities*, Washington, D. C. March, 1979.

SPECIALTIES LIST

MATHEMATICS

000 Algebra
010 Analysis & Functional Analysis
020 Geometry
030 Logic
040 Number Theory
050 Probability & Math. Statistics (see also 544, 670, 725, 727, 920)
060 Topology
080 Computing Theory & Practice
082 Operations Research (see also 478)
085 Applied Mathematics
098 Mathematics, General
099 Mathematics, Other*

COMPUTER SCIENCES

079 Computer Sciences* (see also 437)

ASTRONOMY

101 Astonomy
102 Astrophysics

PHYSICS

110 Atomic & Molecular
132 Acoustics
134 Fluids
135 Plasma
136 Optics
138 Thermal
140 Elementary Particles
150 Nuclear Structure
160 Solid State
188 Physics, General
199 Physics, Other*

CHEMISTRY

200 Analytical
210 Inorganic
220 Organic
230 Nuclear
240 Physical
250 Theoretical
270 Pharmaceutical
275 Polymer
298 Chemistry, General
299 Chemistry, Other*

EARTH, ENVIRONMENTAL AND MARINE SCIENCES

301 Mineralogy, Petrology
305 Geochemistry
310 Stratigraphy, Sedimentation
320 Paleontology
330 Structural Geology
341 Geophysics (Solid Earth)
350 Geomorph. & Glacial Geology
391 Applied Geol., Geol. Engr. & Econ. Geol.
360 Hydrology & Water Resources
370 Oceanography
397 Marine Sciences, Other*
381 Atmospheric Physics and Chemistry
382 Atmospheric Dynamics
383 Atmospheric Sciences, Other*
388 Environmental Sciences, General (see also 480, 528)
389 Environmental Sciences, Other*
398 Earth Sciences, General
399 Earth Sciences, Other*

ENGINEERING

400 Aeronautical & Astronautical
410 Agricultural
415 Biomedical
420 Civil
430 Chemical
435 Ceramic
437 Computer
440 Electrical
445 Electronics
450 Industrial
455 Nuclear
460 Engineering Mechanics
465 Engineering Physics
470 Mechanical
475 Metallurgy & Phys. Met. Engr.
476 Systems Design & Systems Science
478 Operations Research (see also 082)
479 Fuel Tech. & Petrol. Engr.
480 Sanitary & Environmental
486 Mining
497 Materials Science
498 Engineering, General
499 Engineering, Other*

AGRICULTURAL SCIENCES

500 Agronomy
501 Agricultural Economics
502 Animal Husbandry
503 Food Science & Technology
504 Fish & Wildlife
505 Forestry
506 Horticulture
507 Soils & Soil Science
510 Animal Science & Animal Nutrition
511 Phytopathology
518 Agriculture, General
519 Agriculture, Other*

MEDICAL SCIENCES

522 Public Health & Epidemiology
523 Veterinary Medicine
526 Nursing
527 Parasitology
528 Environmental Health
534 Pathology
536 Pharmacology
537 Pharmacy
538 Medical Sciences, General
539 Medical Sciences, Other*

BIOLOGICAL SCIENCES

540 Biochemistry
542 Biophysics
544 Biometrics & Biostatistics (see also 050, 670, 725, 727, 920)
545 Anatomy
546 Cytology
547 Embryology
548 Immunology
550 Botany
560 Ecology
564 Microbiology & Bacteriology
566 Physiology, Animal
567 Physiology, Plant
569 Zoology
570 Genetics
571 Entomology
572 Molecular Biology
576 Nutrition and/or Dietetics
578 Biological Sciences, General
579 Biological Sciences, Other*

PSYCHOLOGY

600 Clinical
610 Counseling & Guidance
620 Developmental & Gerontological
630 Educational
635 School Psychology
641 Experimental
642 Comparative
643 Physiological
650 Industrial & Personnel
660 Personality
670 Psychometrics (see also 050, 544, 725, 727, 920)
680 Social
698 Psychology, General
699 Psychology, Other*

SOCIAL SCIENCES

700 Anthropology
708 Communications*
710 Sociology
720 Economics (see also 501)
725 Econometrics (see also 050, 544, 670, 727, 920)
727 Statistics (see also 050, 544, 670, 725, 920)
740 Geography
745 Area Studies*
751 Political Science
752 Public Administration
755 International Relations
760 Criminology & Criminal Justice
770 Urban & Reg. Planning
798 Social Sciences, General
799 Social Sciences, Other*

HUMANITIES

802 History & Criticism of Art
804 History, American
805 History, European
806 History, Other*
807 History & Philosophy of Science
808 American Studies
809 Theatre and Theatre Criticism
830 Music
831 Speech as a Dramatic Art (see also 885)
832 Archeology
833 Religion (see also 881)
834 Philosophy
835 Linguistics
836 Comparative Literature
878 Humanities, General
879 Humanities, Other*

LANGUAGES & LITERATURE

811 American
812 English
821 German
822 Russian
823 French
824 Spanish & Portuguese
826 Italian
827 Classical*
829 Other Languages*

EDUCATION

900 Foundations: Social & Philosoph.
910 Educational Psychology
908 Elementary Educ., General
909 Secondary Educ., General
918 Higher Education
919 Adult Educ. & Extension Educ.
920 Educ. Meas. & Stat.
929 Curriculum & Instruction
930 Educ. Admin. & Superv.
940 Guid., Couns., & Student Pers.
950 Special Education (Gifted, Handicapped, etc.)
960 Audio-Visual Media

TEACHING FIELDS

970 Agriculture Educ.
972 Art Educ.
974 Business Educ.
975 Early Childhood Educ.
976 English Educ.
978 Foreign Languages Educ.
980 Home Economics Educ.
982 Industrial Arts Educ.
984 Mathematics Educ.
986 Music Educ.
987 Nursing Educ.
988 Phys. Ed., Health, & Recreation
989 Reading Education
990 Science Educ.
992 Social Science Educ.
993 Speech Education
994 Vocational Educ.
996 Other Teaching Fields*
998 Education, General
999 Education, Other*

OTHER PROFESSIONAL FIELDS

881 Theology (see also 833)
882 Business Administration
883 Home Economics
884 Journalism
885 Speech & Hearing Sciences (see also 831)
886 Law & Jurisprudence
887 Social Work
891 Library & Archival Science
897 Professional Field, Other*

899 OTHER FIELDS*

---

* Identify the specific field in the space provided on the questionnaire.

NSF Form 558 1979
OMB No. 99-R0290
Approval Expires June 30, 1981

SURVEY OF EARNED DOCTORATES

This form is to be returned to the GRADUATE DEAN, for forwarding to .... Commission on Human Resources
National Research Council
2101 Constitution Avenue, Washington, D. C. 20418

Please print or type.

1. Name in full: .... (9-30)
(Last Name) (First Name) (Middle Name)

Cross Reference: Maiden name or former name legally changed ....

2. Permanent address through which you could always be reached: (Care of, if applicable) ....
....
(Number) (Street) (City)
....
(State) (Zip Code) (Or Country if not U.S.)

3. U.S. Social Security Number: ___ ___ ___ - ___ ___ - ___ ___ ___ ___ (31-39)

4. Date of birth: .... **Place of birth:** ....
(10-14) (Month) (Day) (Year) (15-16) (State) (Or Country if not U.S.)

5. Sex: 1 ☐ Male 2 ☐ Female (17)

6. Marital status: 1 ☐ Married 2 ☐ Not married (including widowed, divorced) (18)

7. Citizenship: 0 ☐ U.S. native 2 ☐ Non U.S., Immigrant (Permanent Resident)
1 ☐ U.S. naturalized 3 ☐ Non-U.S., Non-Immigrant (Temporary Resident) (19)
If Non-U.S., indicate country of present citizenship .... (20-21)

8. Racial or ethnic group: (Check only one.) *A person having origins in —*
0 ☐ American Indian or Alaskan Native .... any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition.
1 ☐ Asian or Pacific Islander .... any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands. This area includes, for example, China, India, Japan, Korea, the Philippine Islands, and Samoa.
2 ☐ Black, not of Hispanic Origin .... any of the black racial groups of Africa.
3 ☐ White, not of Hispanic Origin .... any of the original peoples of Europe, North Africa, or the Middle East.
4 ☐ Puerto Rican .... Puerto Rico, regardless of race.
5 ☐ Mexican-American .... Mexico, regardless of race.
6 ☐ Other Hispanic .... Central or South America, Cuba, or other Spanish culture, regardless of race. (22-24)

9. Number of dependents: Do not include yourself. (Dependent = someone receiving at least one half of his or her support from you) .... (25)

EDUCATION

10. High school last attended: .... (26-27)
(School Name) (City) (State)

Year of graduation from high school: .... (28-29)

11. List in the table below all collegiate and graduate institutions you have attended including 2-year colleges. List chronologically, and include your doctoral institution as the last entry.

Institution Name	Location	Years Attended		Major Field		Minor Field	Degree (if any)		
				Use Specialties List			Title of Degree	Granted	
		From	To	Name	Number	Number		Mo.	Yr.

12. Enter below the title of your doctoral dissertation and the most appropriate classification number and field. If a project report or a musical or literary composition (not a dissertation) is a degree requirement, please check box. ☐ (12)

Title .... Classify using Specialties List
.... Number Name of field
....

13. Name the department (or interdisciplinary committee, center, institute, etc.) and school or college of the university which supervised your doctoral program: ....
(Department/Institute/Committee/Program) (School)

14. Name of your adviser for dissertation, project report or music/literary composition: ....
(Last Name) (First Name) (Middle Initial)

continued on next page

SURVEY OF EARNED DOCTORATES, Cont.

15. Please enter a "1" beside your primary source of support during graduate study. Enter a "2" beside your secondary source of support during graduate study. Check (✓) all other sources from which support was received.

a — NSF Fellowship
b — NSF Traineeship
c — NIH Fellowship
d — NIH Traineeship
e — NDEA Fellowship
f — Title IX Graduate & Professional Opportunities Pgm. Fellowship
g — Other HEW
h — AEC/ERDA/DOE Fellowship
i — NASA Traineeship
j — GI Bill
k — Other Federal support (specify) ....
l — Woodrow Wilson Fellowship
m — Other U.S. national fellowship (specify) ....
n — University Fellowship
o — Teaching Assistantship
p — Research Assistantship
q — Educational fund of industrial or business firm
r — Other institutional funds (specify) ....
s — Own earnings
t — Spouse's earnings
u — Family contributions
v — Loans (NDSL direct)
w — Other loans
x — Other (specify) ....

(26-49)

16. Please check the space which most fully describes your status during the year immediately preceding the doctorate.

0 ☐ Held fellowship
1 ☐ Held assistantship
2 ☐ Held own research grant
3 ☐ Not employed
4 ☐ Part-time employed

Full-time Employed in: (Other than 0, 1, 2)
5 ☐ College or university, teaching
6 ☐ College or university, non-teaching
7 ☐ Elem. or sec. school, teaching
8 ☐ Elem. or sec. school, non-teaching
9 ☐ Industry or business
(11) ☐ Other (specify) ....

(12) ☐ Any other (specify) .... (50)

POSTGRADUATION PLANS

17. How well defined are your postgraduation plans?
0 ☐ Am returning to, or continuing in, predoctoral employment
1 ☐ Have signed contract or made definite commitment
2 ☐ Am negotiating with one or more specific organizations
3 ☐ Am seeking appointment but have no specific prospects
4 ☐ Other (specify) .... (51)

18. What are your immediate postgraduation plans?
0 ☐ Postdoctoral fellowship
1 ☐ Postdoctoral research associateship
2 ☐ Traineeship
3 ☐ Other study (specify) ....
Go to Item "19"
4 ☐ Employment (other than 0, 1, 2, 3)
5 ☐ Military service
6 ☐ Other (specify) .... (52)
Go to Item "20"

19. If you plan to be on a postdoctoral fellowship, associateship, traineeship or other study

a. What was the most important reason for taking a postdoctoral appointment? (Check only one.)
0 ☐ To obtain additional research experience in my doctoral field
1 ☐ To work with a particular scientist or research group
2 ☐ To switch into a different field of research
3 ☐ Could not obtain the desired type of employment position
4 ☐ Other reason (specify) .... (53)

b. What will be the field of your postdoctoral study?
Please enter number from Specialties List .... (54-56)

What will be the primary source of research support?
0 ☐ U.S. Government
1 ☐ College or university
2 ☐ Private foundation
3 ☐ Nonprofit, other than private foundation
4 ☐ Other (specify)
....
6 ☐ Unknown (57)
Go to Item "21"

20. If you plan to be employed, enter military service, or other —

a. What will be the type of employer?
0 ☐ 4-year college or university other than medical school
1 ☐ Medical school
2 ☐ Jr. or community college
3 ☐ Elem. or sec. school
4 ☐ Foreign government
5 ☐ U.S. Federal government
6 ☐ U.S. state government
7 ☐ U.S. local government
8 ☐ Nonprofit organization
9 ☐ Industry or business
(11) ☐ Self-employed
(12) ☐ Other (specify) .... (58)

b. Indicate what your *primary* work activity will be with "1" in appropriate box; *secondary* work activity (if any) with "2" in appropriate box.
0 ☐ Research and development
1 ☐ Teaching
2 ☐ Administration
3 ☐ Professional services to individuals
5 ☐ Other (specify) .... (59-60)

c. In what field will you be working?
Please enter number from Specialties List .... (61-63)

d. Did you consider taking a postdoctoral appointment?
Yes ___ No ___ (64)
If yes, why did you decide against the postdoctoral?
0 ☐ No postdoctoral appointment available
1 ☐ Felt that I would derive little or no benefit from a postdoctoral appointment
2 ☐ Had more attractive employment opportunity
3 ☐ Other (specify) .... (65)
Go to Item "21"

21. What is the name and address of the organization with which you will be associated?

....
(Name of Organization)

.... (Street) .... (City, State) (Or Country if not U.S.) (66-71)

BACKGROUND INFORMATION

22. Please indicate, by circling the highest grade attained, the education of

		Elementary school			High school		College		Graduate		Postdoctoral	
your father:	none	1 2 3	4 5 6	7 8	9 10 11	12	1 2 3	4	MA, MD	PhD	Postdoctoral	(72)
your mother	none	1 2 3	4 5 6	7 8	9 10 11	12	1 2 3	4	MA, MD	PhD	Postdoctoral	(73)
	0	1	2	3	4	5	6	7	8	9	(11)	

Signature .... Date ....
(74-78)

TABLE B.1 Oceanography Ph.D.'s Awarded Annually by Sex and Citizenship, 1958-1978[a]

Year	Total Number	Foreign Number	Foreign Percent	Women Number	Women Percent
1958	14	2	14.3	1	7.1
1958	8	0	--	0	--
1960	6	1	16.7	0	--
1961	8	1	12.5	0	--
1962	14	0	--	0	--
1963	15	3	20.0	0	--
1964	18	3	16.7	0	--
1965	29	4	13.8	0	--
1966	39	4	10.3	0	--
1967	48	3	6.3	1	2.1
1968	49	7	14.2	1	2.0
1969	42	6	14.3	3	7.1
1970	66	4	6.0	2	3.0
1971	53	6	11.4	1	1.9
1972	78	6	7.6	1	1.3
1973	88	12	13.7	4	4.5
1974	81	13	16.0	8	9.9
1975	86	12	13.9	3	3.5
1976	89	14	15.7	14	15.7
1977	112	17	15.2	5	4.5
1978	126	14	11.1	14	11.1
	1069	132	12.3	58	5.4

[a] Data Source: Annual Census (NRC Survey of Earned Doctorates).

TABLE B.2 Oceanography Ph.D. Recipients Compared with Ph.D.'s in Earth Sciences, Physical Sciences, and Life Sciences, 1976 and 1977[a,b]

	Oceanography		Earth Sciences		Physical Sciences		Life Sciences		Total Sciences	
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Number in Field	89	112	584	691	3442	3410	4971	4767	18790	18281
Male (%)	84.3	95.5	90.9	91.5	91.4	91.1	80.5	79.9	83.2	82.0
Female (%)	15.7	4.5	9.1	8.5	8.6	8.9	19.5	20.1	16.8	18.0
U.S. citizen (%)	82.0	83.9	77.6	80.5	76.1	86.9	78.8	78.7	77.1	76.9
Foreign (%)	15.7	15.2	20.9	17.7	22.2	21.1	18.7	18.9	20.8	20.3
Unknown (%)	2.2	0.9	1.5	1.9	1.7	2.0	2.5	2.4	2.1	2.8
Median age at doctorate receipt	30.0	30.6	30.3	30.5	29.0	29.2	29.9	30.0	30.0	30.1
% with Baccalureate in same field as Ph.D.	3.4	3.6	51.4	46.3	78.5	76.5	41.8	41.1	62.1	61.3
% with Masters in same field as Ph.D.	62.9	75.9	79.6	79.5	56.8	56.9	63.7	62.5	74.1	73.1
Median years, Baccalureate to Ph.D.										
Total Time	7.5	8.2	7.8	8.0	6.7	6.9	7.3	7.2	7.3	7.4
Registered Time	5.5	6.1	5.9	5.9	5.6	5.7	5.6	5.7	5.7	5.7

Postdoctoral study plans	42.7	40.2	27.7	25.9	46.4	42.6	44.9	47.1	26.7	26.6
Fellowship	13.5	14.3	11.0	9.8	19.8	16.0	26.4	28.1	13.4	13.2
Research Associate	29.2	25.9	16.6	15.9	25.0	25.3	13.2	14.1	10.4	10.8
Traineeship	0.0	0.0	.0	0.0	.5	.4	1.2	1.7	.9	1.1
Other	0.0	0.0	.2	0.1	1.0	.8	4.1	3.2	2.0	1.6
Planned employment after Doctorate (%)	48.3	56.3	66.6	68.0	46.7	50.1	48.5	46.7	66.8	66.1
Educ. institution	22.0	20.5	26.7	27.9	16.3	16.9	28.2	27.7	36.5	34.8
Industry/business	0.0	12.5	19.2	18.2	19.4	21.0	6.9	6.8	13.3	13.9
Government	23.0	18.8	16.8	18.4	7.7	8.9	8.7	8.0	10.2	10.6
Nonprofit	0.0	0.9	1.2	1.3	.8	1.2	2.0	2.0	3.5	3.8
Other and unknown	3.3	3.6	2.7	2.2	2.5	2.1	2.8	2.2	3.2	3.0
Status unknown	9.0	3.6	5.7	6.1	6.9	7.3	6.6	6.2	6.5	7.3
Primary employment activity after doctorate (%)										
R&D	56.8	55.6	49.0	48.0	59.3	58.9	41.4	41.3	35.6	36.9
Teaching	18.2	19.0	28.0	27.7	25.9	25.1	35.7	35.5	39.8	38.3
Administration	6.8	7.9	2.6	3.6	1.7	2.4	5.3	4.1	4.1	4.2
Professional Serv.	4.5	3.2	9.2	7.3	4.0	3.7	6.6	7.3	11.1	11.3
Other	2.3	3.2	4.3	4.7	3.1	2.5	2.8	2.5	2.4	2.3
Activity unknown	8.1	11.1	5.9	8.7	6.0	7.5	8.1	9.4	6.9	7.1

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[a] Data Source: Annual Census (NRC Survey of Earned Doctorates).

[b] Note: Postdoctoral study plans, planned employment after doctorate, and status unknown equals 100%.

TABLE B.3 Institutions of Oceanography Ph.D. Recipients, 1958-1979[a]

	Fiscal Year of Doctorate																						
Ph.D. Institution	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80	Total
Alaska, U. of								1					1	3		1	1	1	1		1	1		11
Brown University																			1					1
Calif. Inst. Tech.							1																	1
Calif., U. of at L.A.	8	4	3	1																				16
Calif., U. of at Riverside														1										1
Calif., U. of at San Diego				3	3	2	5	8	8	9	6	6	11	9	8	12	7	14	11	17	23	13		175
Calif., U. of at Santa Cruz																1						1		2
Chicago, U. of/IL								1	2	1	1									2				7
City U. of New York																					2	2		4
Colorado, U. of/Boulder																				1				1
Columbia U. of New York							1	1		1	2	1		2	2	4		1		1	4	3		23
Connecticut, U. of																			2	1	1	3		7
Cornell U. of New York							1			1														2
Delaware, U. of																		2	1		3	2		8
Duke U. of North Carolina																	1			1				2
Florida State U.													1	3	7	6	4	4	4	7	5	3		44
Florida, U. of																				1				1
Georgia, U. of																					1			1
Harvard U./MA									1	1				1				1	1					5
Hawaii, U. of											1		2	2		5	2	3	3	6	5	4		33
Ill. U. of/Urbana-Champ.												2	1											3
Johns Hopkins U./MD			1		1	1				2	4	1	3	1	3	3	4	3	3					30
Lehigh U./PA							1													1				2
La. St. U. & A&M C.														2		1	1	1		1	1	4		11
Maine, U. of Orono																		2						2
Mass. Inst. Tech.						2	1	2	4	5	4	3	6	4	7	4	5	5	12	8	7	8		87
Mass. U. of, Amherst																						1		1
Miami, U. of/FL						2	1		4	5	1	4	3	3		1	3	2	6	6	8	7		56
Michigan State U.															1									1
Michigan, U. of								1				2	5			2	2	3	2	2	1	1		21
Naval Postgrad S/CA																			1	1				2
New Hampshire, U. of																				1				1
New York U.	1					3				1	1	1	1	3	3	1	5	1	2	3	1	7		34
NC State U./Raleigh															1	2		1	1	2	3	2		12
NC, U. of/Chapel Hill															1		2		2	1	2	4		12

Nova U./FL																	1				1		2
Ohio State U.												1											1
Old Dominion																				1	2	2	5
Oregon State U.					1	1	1	4	5	7	16	7	10	7	15	8	11	9	3	15	6	6	132
Princeton U./NJ																	1	2			1		4
Purdue U./IN																					1		1
Rensselaer Poly Inst./NY														1									1
Rhode Island, U. of					1		1	4	4	5	4	2	5		7	14	12	12	12	12	22	15	132
Rice U./TX																			1				1
Rochester, U. of																				1			1
South Carolina, U. of																1			1	1	1	7	11
South Florida U.																					1		1
Southern Calif., U. of			1		1		1	2	2				3		1					2			13
Southern Miss., U. of																						1	1
Stanford U./CA										1											2	1	4
SUNY at Albany																			1				1
Texas A&M U.	5	3		3	5	3	3	3	6	4	5	8	12	4	9	9	8	11	6	12	8	11	138
Utah State U.											1											1	2
Virginia, U. of															1			1			2	1	5
Washington, U. of		1	1	1	2		1	2	3	4	1	2	2	6	4	10	7	6	2	10	5	8	78
William & Mary C/VA											1	1			6		3		4	3	4		22
Wisconsin, U. of, Madison											1	1		1	2	3	1	1	6	1	2	3	22
Wisconsin, U. of, Milwaukee																						1	1
Yale U./CT						1				1										1			3
TOTAL	14	8	6	8	14	15	18	29	39	48	49	42	66	53	78	88	81	86	89	122	126	122	1201

[a]Data Source: Annual Census (NRC Survey of Earned Doctorates).

TABLE B.4 Inferred Subfields of Oceanography Ph.D.'s by Year of Ph.D. Degree Received, 1958-1978[a]

Year	Oceanography Subfields[a]					
	Total	Physical	Chemical	Geological	Biological	Other/ Unknown
1958	14	1	0	5	4	4
1959	8	5	0	2	1	0
1960	6	0	0	4	1	1
1961	8	0	2	2	3	1
1962	14	0	1	5	6	2
1963	15	4	3	1	3	4
1964	18	3	1	7	2	5
1965	29	2	1	9	7	10
1966	39	4	3	11	7	14
1967	48	9	3	11	9	16

1968	49	5	0	19	8	17
1969	42	5	7	10	5	15
1970	66	9	5	21	12	19
1971	53	6	4	13	6	24
1972	78	22	5	13	12	26
1973	88	10	15	16	13	34
1974	81	10	7	17	20	27
1975	86	8	10	7	20	41
1976	89	12	8	7	21	41
1977	112	20	13	12	32	35
1978	126	20	11	6	39	50
TOTAL	1069	155	99	198	231	386
Percent	100	14	9	19	22	36

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[a] Data Source: Annual Census (NRC Survey of Earned Doctorates).

[b] Inferred from field of Masters and/or field of Baccalaureate.

TABLE B.5 Age at Receipt of Oceanography Ph.D., 1958-1979[a]

		YEAR OF DOCTORATE											
AGE AT DOCTORATE		1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
25	N						1		1	1	1		
	V						6.7		3.4	2.6	2.1		
26	N							1		2	1	2	1
	V							5.6		5.1	2.1	4.1	2.4
27	N					1		1	3	3	3	2	6
	V					7.1		5.6	10.3	7.7	6.3	4.1	14.3
28	N	1				1	1		3	3	10	6	4
	V	7.1				7.1	6.7		10.3	7.7	20.8	12.2	9.5
29	N	1	1			1	2	4	5	3	5	8	3
	V	7.1	12.5			7.1	13.3	22.2	17.2	7.7	10.4	16.3	7.1
30	N	1	1	2	2			1	2	3	3	1	5
	V	7.1	12.5	33.3	25.0			5.6	6.9	7.7	6.3	2.0	11.9
31	N	1		2		1	1	2	2	7	5	4	5
	V	7.1		33.3		7.1	6.7	11.1	6.9	17.9	10.4	8.2	11.9
32	N	2	1		2	1	1		1	1	2	3	
	V	14.3	12.5		25.0	7.1	6.7		3.4	2.6	4.2	6.1	
33	N	2			1	1	2	2			3	1	4
	V	14.3			12.5	7.1	13.3	11.1			6.3	2.0	9.5
34	N	1	2			1	1		1	1	3		1
	V	7.1	25.0			7.1	6.7		3.4	2.6	6.3		2.4
35	N	1				1		2	2	3	4	5	2
	V	7.1				7.1		11.1	6.9	7.7	8.3	10.2	4.8
36	N	2		1		2			1	2	2	1	
	V	14.3		16.7		14.3			3.4	5.1	4.2	2.0	
37	N		1		1	2		3	1	3	2	3	1
	V		12.5		12.5	14.3		16.7	3.4	7.7	4.2	6.1	2.4
38	N						2		3	2	1	3	2
	V						13.3		10.3	5.1	2.1	6.1	4.8
39	N		1								1	2	1
	V		12.5								2.1	4.1	2.4
40 + 41	N	1			1	1	2		2			2	1
	V	7.1			12.5	7.1	13.3		6.9			4.1	2.4
42 + 43	N	1			1		1		1	1		1	
	V	7.1			12.5		6.7		3.4	2.6		2.0	
44 + 45	N		1						1	1	2	1	2
	V		12.5						3.4	2.6	4.2	2.0	4.8
46 TO 49	N			1		1	1	2		1		3	2
	V			16.7		7.1	6.7	11.1		2.6		6.1	4.8
50 + OLDER	N											1	1
	V											2.0	2.4
TOTAL KNOWN	N	14	8	6	8	14	15	18	29	37	48	49	41
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	94.9	100.0	100.0	97.6
UNKNOWN AGE	N									2			1
	V									5.1			2.4
GRAND TOTAL	N	14	8	6	8	14	15	18	29	39	48	49	42
50 PCTILE		*	*	*	*	*	*	*	30.75	31.00	30.70	32.00	30.80

		YEAR OF DOCTORATE									
AGE AT DOCTORATE		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
24 + YOUNGER	N				1						
	V				1.1						
25	N		1			1		2			
	V		1.9			1.2		2.2			
26	N	3	2	7	5	3	7	2	2	3	9
	V	4.5	3.8	9.0	5.7	3.7	8.1	2.2	1.6	2.4	7.4
27	N	9	5	2	5	5	8	15	12	12	13
	V	13.6	9.4	2.6	5.7	6.2	9.3	16.9	9.8	9.5	10.7
28	N	8	9	13	16	5	9	8	15	15	16
	V	12.1	17.0	16.7	18.2	6.2	10.5	9.0	12.3	11.9	13.1
29	N	8	2	14	10	8	10	10	14	14	15
	V	12.1	3.8	17.9	11.4	9.9	11.6	11.2	11.5	11.1	12.3
30	N	4	5	12	14	10	6	13	18	12	14
	V	6.1	9.4	15.4	15.9	12.3	7.0	14.6	14.8	9.5	11.5
31	N	6	4	4	9	10	11	12	13	17	10
	V	9.1	7.5	5.1	10.2	12.3	12.8	13.5	10.7	13.5	8.2
32	N	6	3	6	8	7	6	8	13	16	7
	V	9.1	5.7	7.7	9.1	8.6	7.0	9.0	10.7	12.7	5.7
33	N	4	6	3	4	8	11	4	9	6	12
	V	6.1	11.3	3.8	4.5	9.9	12.8	4.5	7.4	4.8	9.8
34	N	4	3	5	3	6	2		11	3	2
	V	6.1	5.7	6.4	3.4	7.4	2.3		9.0	2.4	1.6
35	N	4	4	2	1	4	4	2	3	5	2
	V	6.1	7.5	2.6	1.1	4.9	4.7	2.2	2.5	4.0	1.6
36	N	2	1	2	3	2	2	4	3	8	3
	V	3.0	1.9	2.6	3.4	2.5	2.3	4.5	2.5	6.3	2.5
37	N	1	2	1	2	1	2	2	3	5	6
	V	1.5	3.8	1.3	2.3	1.2	2.3	2.2	2.5	4.0	4.9
38	N			1	1	2	1	2	1	1	1
	V			1.3	1.1	2.5	1.2	2.2	.8	.8	.8
39	N	1	3	1	1	1	3	1		1	
	V	1.5	5.7	1.3	1.1	1.2	3.5	1.1		.8	
40 + 41	N	2	1	1	2	2	1			3	7
	V	3.0	1.9	1.3	2.3	2.5	1.2			2.4	5.7
42 + 43	N	3				2		1	1	4	
	V	4.5				2.5		1.1	.8	3.2	
44 + 45	N			1	2	1		1	1		1
	V			1.3	2.3	1.2		1.1	.8		.8
46 TO 49	N		1	2		2	3		1	1	2
	V		1.9	2.6		2.5	3.5		.8	.8	1.6
50 + OLDER	N	1	1		1						
	V	1.5	1.9		1.1						
TOTAL KNOWN	N	66	53	77	88	80	86	87	120	126	120
	V	100.0	100.0	98.7	100.0	98.8	100.0	97.8	98.4	100.0	98.4
UNKNOWN AGE	N			1		1		2	2		2
	V			1.3		1.2		2.2	1.6		1.6
GRAND TOTAL	N	66	53	78	88	81	86	89	122	126	122
50 PCTILE		30.67	31.13	29.71	30.00	31.30	30.77	30.00	30.44	30.91	30.00

[a] Data Source: Annual Census (NRC Survey of Earned Doctorates).

TABLE B.6 Registered Time, B.A.-Ph.D. for Oceanography Ph.D.'s 1958-1979

YEARS REGISTERED TIME BA-PHD		YEAR CF DOCTORATE 1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
0-3	N	1					1			1	2
	V	7.1					6.7			2.6	4.2
4	N			1	1		1		1	4	5
	V			16.7	12.5		6.7		3.4	10.3	10.4
5	N	2	3	3	3	5	2	4	9	7	8
	V	14.3	37.5	50.0	37.5	35.7	13.3	22.2	31.0	17.9	16.7
6	N	1	2	1	2	2	4	4	3	9	18
	V	7.1	25.0	16.7	25.0	14.3	26.7	22.2	10.3	23.1	37.5
7	N	4				2	4	3	7	3	5
	V	28.6				14.3	26.7	16.7	24.1	7.7	10.4
8	N	1	2		1	2		3	5	5	3
	V	7.1	25.0		12.5	14.3		16.7	17.2	12.8	6.3
9	N		1	1				2		4	2
	V		12.5	16.7				11.1		10.3	4.2
10	N	1				1		1		3	1
	V	7.1				7.1		5.6		7.7	2.1
11	N	2								1	
	V	14.3								2.6	
12	N				1		2		1		
	V				12.5		13.3		3.4		
13	N										1
	V										2.1
14	N							1	1		
	V							5.6	3.4		
15	N								1		
	V								3.4		
16-17	N										
	V										
20-21	N										
	V										
TCTAL KNOWN	N	12	8	6	8	12	14	18	28	37	45
	V	85.7	100.0	100.0	100.0	85.7	93.3	100.0	96.6	94.9	93.8
UNKNOWN	N	2				2	1		1	2	3
	V	14.3				14.3	6.7		3.4	5.1	6.3
GRAND TOTAL	N	14	8	6	8	14	15	18	29	39	48
50 PCTILE		*	*	*	*	*	*	*	6.64	6.22	5.92

Data Source: Annual Census (NRC Survey of Earned Doctorates).

YEAR OF DOCTORATE

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1 2.0	3 7.1			1 1.3	3 3.4	1 1.2	2 2.3	4 4.5	3 2.5		1 .8
10 20.4	4 9.5	7 10.6	10 18.9	9 11.5	9 10.2	10 12.3	9 10.5	11 12.4	8 6.6	7 5.6	12 9.8
8 16.3	6 14.3	16 24.2	13 24.5	13 16.7	17 19.3	18 22.2	15 17.4	27 30.3	25 20.5	30 23.8	27 22.1
12 24.5	13 31.0	11 16.7	11 20.8	21 26.9	18 20.5	16 19.8	15 17.4	17 19.1	38 31.1	25 19.8	25 20.5
8 16.3	7 16.7	15 22.7	5 9.4	12 15.4	15 17.0	17 21.0	15 17.4	12 13.5	15 12.3	20 15.9	19 15.6
2 4.1	4 9.5	6 9.1	5 9.4	9 11.5	11 12.5	5 6.2	14 16.3	4 4.5	14 11.5	15 11.9	12 9.8
	1 2.4	5 7.6	3 5.7	3 3.8	6 6.8	4 4.9	7 8.1	5 5.6	5 4.1	7 5.6	9 7.4
		2 3.0	3 5.7	5 6.4	1 1.1	1 1.2	3 3.5	1 1.1	3 2.5	2 1.6	2 1.6
1 2.0		1 1.5	1 1.9		4 4.5	2 2.5	2 2.3			2 1.6	1 .8
					1 1.1		1 1.2	1 1.1	3 2.5	4 3.2	2 1.6
	1 2.4	1 1.5					1 1.2			2 1.6	
								1 1.1			2 1.6
											1 .8
					1 1.1						
											1 .8
42 85.7	39 92.9	64 97.0	51 96.2	73 93.6	86 97.7	74 91.4	84 97.7	83 93.3	114 93.4	114 90.5	114 93.4
7 14.3	3 7.1	2 3.0	2 3.8	5 6.4	2 2.3	7 8.6	2 2.3	6 6.7	8 6.6	12 9.5	8 6.6
49	42	66	53	78	88	81	86	89	122	126	122
5.67	6.00	6.32	5.73	6.14	6.28	6.00	6.57	5.48	6.05	6.30	6.18

TABLE B.7 Total Time, B.A.-Ph.D., for Oceanography Ph.D.'s, 1958-1979

YEARS TOTAL TIME BA-PHD		YEAR OF DOCTORATE 1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
3	N									1	
	V									2.6	
4	N						1		1	2	1
	V						6.7		3.4	5.1	2.1
5	N					1		2	1	5	6
	V					7.1		11.1	3.4	12.8	12.5
6	N	1	1	1		1	1	2	6	4	12
	V	7.1	12.5	16.7		7.1	6.7	11.1	20.7	10.3	25.0
7	N	1	1		1	1	2	2	4	2	7
	V	7.1	12.5		12.5	7.1	13.3	11.1	13.8	5.1	14.6
8	N	3		3	2		1	3	6	4	2
	V	21.4		50.0	25.0		6.7	16.7	20.7	10.3	4.2
9	N	3		1	1	2				7	3
	V	21.4		16.7	12.5	14.3				17.9	6.3
10	N	2	2		1	1	1	4			4
	V	14.3	25.0		12.5	7.1	6.7	22.2			8.3
11	N	1			2	2	3	1	1	2	2
	V	7.1			25.0	14.3	20.0	5.6	3.4	5.1	4.2
12-13	N	1	2		1	2	2	2	4	6	4
	V	7.1	25.0		12.5	14.3	13.3	11.1	13.8	15.4	8.3
14-15	N		1			2	2	1	3	3	2
	V		12.5			14.3	13.3	5.6	10.3	7.7	4.2
16-17	N					1	1		2	1	4
	V					7.1	6.7		6.9	2.6	8.3
18-19	N	2								2	
	V	14.3								5.1	
20-24	N		1	1		1		1	1		1
	V		12.5	16.7		7.1		5.6	3.4		2.1
25 OR MORE	N						1				
	V						6.7				
TOTAL KNOWN	N	14	8	6	8	14	15	18	29	39	48
	V	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
UNKNOWN	N										
	V										
GRAND TOTAL	N	14	8	6	8	14	15	18	29	39	48
50 PCTILE		*	*	*	*	*	*	*	7.92	8.71	7.21

Data Source: Annual Census (NRC Survey of Earned Doctorates).

YEAR OF DOCTORATE

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
					1 1.1	1 1.2		1 1.1			
3 6.1	3 7.1	2 3.0	5 9.4	6 7.7	6 6.8	2 2.5	6 7.0	2 2.2	2 1.6	3 2.4	6 4.9
1 2.0	3 7.1	8 12.1	5 9.4	5 6.4	6 6.8	7 8.6	9 10.5	20 22.5	13 10.7	12 9.5	17 13.9
9 18.4	7 16.7	11 16.7	9 17.0	17 21.8	18 20.5	6 7.4	15 17.4	9 10.1	16 13.1	22 17.5	17 13.9
6 12.2	5 11.9	11 16.7	5 9.4	10 12.8	16 18.2	15 18.5	9 10.5	12 13.5	16 13.1	15 11.9	20 16.4
5 10.2	6 14.3	7 10.6	3 5.7	13 16.7	8 9.1	9 11.1	11 12.8	11 12.4	22 18.0	15 11.9	12 9.8
3 6.1	3 7.1	5 7.6	5 9.4	3 3.8	9 10.2	11 13.6	9 10.5	12 13.5	20 16.4	17 13.5	13 10.7
		5 7.6	3 5.7	7 9.0	6 6.8	6 7.4	8 9.3	8 9.0	13 10.7	11 8.7	9 7.4
5 10.2	2 4.8	3 4.5	7 13.2	2 2.6	5 5.7	4 4.9	5 5.8	2 2.2	6 4.9	7 5.6	8 6.6
3 6.1	5 11.9	4 6.1	6 11.3	8 10.3	4 4.5	10 12.3	5 5.8	1 1.1	5 4.1	3 2.4	7 5.7
3 6.1	2 4.8	4 6.1	2 3.8	2 2.6	1 1.1	1 1.2	3 3.5	5 5.6	3 2.5	13 10.3	7 5.7
4 8.2	1 2.4	2 3.0	1 1.9	2 2.6	5 5.7	3 3.7	2 2.3	2 2.2	2 1.6	1 .8	1 .8
2 4.1	2 4.8			1 1.3	1 1.1	2 2.5	1 1.2			2 1.6	2 1.6
3 6.1	2 4.8	3 4.5	1 1.9	2 2.6	1 1.1	3 3.7		2 2.2	2 1.6	2 1.6	1 .8
2 4.1			1 1.9		1 1.1		2 2.3		1 .8		2 1.6
49 100.0	41 97.6	65 98.5	53 100.0	78 100.0	88 100.0	80 98.8	85 98.8	87 97.8	121 99.2	123 97.6	122 100.0
	1 2.4	1 1.5				1 1.2	1 1.2	2 2.2	1 .8	3 2.4	
49	42	66	53	78	88	81	86	89	122	126	122
8.67	7.92	7.57	8.33	7.58	7.31	8.50	7.82	7.46	8.11	8.13	7.58

TABLE B.8 Total Time, Graduate Entrance-Ph.D., for Oceanography Ph.D.'s, 1958-1979

YEARS GRADUATE ENTRANCE-PHD		YEAR OF DOCTORATE 1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
3	N						1			1	
	V						6.7			2.6	
4	N	1					1		1	3	3
	V	7.1					6.7		3.4	7.7	6.3
5	N			1	3	2		2	3	6	7
	V			16.7	37.5	14.3		11.1	10.3	15.4	14.6
6	N	1	1	2	1	2	2	4	5	3	13
	V	7.1	12.5	33.3	12.5	14.3	13.3	22.2	17.2	7.7	27.1
7	N		1		1	1	2	2	7	4	7
	V		12.5		12.5	7.1	13.3	11.1	24.1	10.3	14.6
8	N	5		2	1		2	3	3	4	4
	V	35.7		33.3	12.5		13.3	16.7	10.3	10.3	8.3
9	N							2		6	4
	V							11.1		15.4	8.3
10	N	3	2		1	2	1	2	1		2
	V	21.4	25.0		12.5	14.3	6.7	11.1	3.4		4.2
11	N	1	1			1	1			4	2
	V	7.1	12.5			7.1	6.7			10.3	4.2
12-13	N		1		1	2	1	1	5	2	1
	V		12.5		12.5	14.3	6.7	5.6	17.2	5.1	2.1
14-15	N		1			1	2	1	2	2	2
	V		12.5			7.1	13.3	5.6	6.9	5.1	4.2
16-17	N			1			2		1		2
	V			16.7			13.3		3.4		4.2
18-19	N	1				1				2	
	V	7.1				7.1				5.1	
20-24	N		1					1	1		
	V		12.5					5.6	3.4		
25 OR MORE	N										
	V										
TOTAL KNOWN	N	12	8	6	8	12	15	18	29	37	47
	V	85.7	100.0	100.0	100.0	85.7	100.0	100.0	100.0	94.9	97.9
UNKNOWN	N	2				2				2	1
	V	14.3				14.3				5.1	2.1
GRAND TOTAL	N	14	8	6	8	14	15	18	29	39	48
50 PCTILE		*	*	*	*	*	*	*	7.29	7.88	6.57

Data Source: Annual Census (NRC Survey of Earned Doctorates).

YEAR OF DOCTORATE

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
					2	1	1	2	2		
					2.3	1.2	1.2	2.2	1.6		
4	4	5	7	8	7	5	8	6	2	4	8
8.2	9.5	7.6	13.2	10.3	8.0	6.2	9.3	6.7	1.6	3.2	6.6
5	4	9	8	7	9	12	8	22	16	25	20
10.2	9.5	13.6	15.1	9.0	10.2	14.8	9.3	24.7	13.1	19.8	16.4
8	8	11	10	23	20	9	15	14	26	25	23
16.3	19.0	16.7	18.9	29.5	22.7	11.1	17.4	15.7	21.3	19.8	18.9
8	7	13	5	10	16	18	11	13	19	16	26
16.3	16.7	19.7	9.4	12.8	18.2	22.2	12.8	14.6	15.6	12.7	21.3
3	5	9	3	10	9	8	11	8	17	19	12
6.1	11.9	13.6	5.7	12.8	10.2	9.9	12.8	9.0	13.9	15.1	9.8
3	3	4	9	3	11	9	10	10	13	9	10
6.1	7.1	6.1	17.0	3.8	12.5	11.1	11.6	11.2	10.7	7.1	8.2
2	1	5	1	6	4	3	6	5	7	7	2
4.1	2.4	7.6	1.9	7.7	4.5	3.7	7.0	5.6	5.7	5.6	1.6
2	2	4	3	3	2	3	5	2	5	3	5
4.1	4.8	6.1	5.7	3.8	2.3	3.7	5.8	2.2	4.1	2.4	4.1
6	3	1	2	3	3	6	5	1	4	5	3
12.2	7.1	1.5	3.8	3.8	3.4	7.4	5.8	1.1	3.3	4.0	2.5
		2	1	1		2	1	2	2	6	5
		3.0	1.9	1.3		2.5	1.2	2.2	1.6	4.8	4.1
3	1	1	1	1	2	1	1	1	1	1	3
6.1	2.4	1.5	1.9	1.3	2.3	1.2	1.2	1.1	.8	.8	2.5
	1				1	1	1		1	1	1
	2.4				1.1	1.2	1.2		.8	.8	.8
1	2	1	2		1		1	1			
2.0	4.8	1.5	3.8		1.1		1.2	1.1			
2					1						1
4.1					1.1						.8
47	41	65	52	75	88	78	84	87	115	121	119
95.9	97.6	98.5	98.1	96.2	100.0	96.3	97.7	97.8	94.3	96.0	97.5
2	1	1	1	3		3	2	2	7	5	3
4.1	2.4	1.5	1.9	3.8		3.7	2.3	2.2	5.7	4.0	2.5
49	42	66	53	78	88	81	86	89	122	126	122
7.31	7.14	7.08	6.70	6.48	6.88	7.17	7.41	6.46	7.11	6.91	6.83

TABLE B.9 Postdoctoral Employment Plans of Oceanography Ph.D.'s, 1958-1979

POSTGRADUATION PLANS		YEAR OF DOCTORATE									
		1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
SIGNED CONTR.	N	11	7	4	8	13	12	15	25	20	40
	V1	78.6	87.5	66.7	100.0	92.9	80.0	83.3	86.2	51.3	83.3
NEGOTIATING	N		1	1		1	2	2	2	4	1
	V1		12.5	16.7		7.1	13.3	11.1	6.9	10.3	2.1
SEEKING	N	2								1	
	V1	14.3								2.6	
OTHER	N										
	V1										
UNKNOWN	N	1		1			1	1	2	14	7
	V1	7.1		16.7			6.7	5.6	6.9	35.9	14.6
TOTAL PHD'S	N	14	8	6	8	14	15	18	29	39	48
FELLOWSHIP	N			1					1	11	5
	V2			16.7					3.4	28.2	10.4
RESEAR. A'SHIP	N										
	V2										
TRAINEESHIP	N										
	V2										
EMPLOYED	N	13	8	5	8	14	13	17	26	24	40
	V2	92.9	100.0	83.3	100.0	100.0	86.7	94.4	89.7	61.5	83.3
MILITARY SERV.	N						1		1	1	1
	V2						6.7		3.4	2.6	2.1
UNKNOWN	N	1					1	1	1	3	2
	V2	7.1					6.7	5.6	3.4	7.7	4.2
OTHER	N										
	V2										
UNKNOWN	N										
	V2										

Data Source: Annual Census (NRC Survey of Earned Doctorates).

YEAR OF DOCTORATE

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
34	32	53	47	58	57	59	65	58	87	89	85
69.4	76.2	80.3	88.7	74.4	64.8	72.8	75.6	65.2	71.3	70.6	69.7
4	7	9	4	13	14	11	12	14	13	22	20
8.2	16.7	13.6	7.5	16.7	15.9	13.6	14.0	15.7	10.7	17.5	16.4
2	2	4	1	4	14	6	6	10	16	14	10
4.1	4.8	6.1	1.9	5.1	15.9	7.4	7.0	11.2	13.1	11.1	8.2
1								1			
2.0								1.1			
8	1		1	3	3	5	3	6	6	1	7
16.3	2.4		1.9	3.8	3.4	6.2	3.5	6.7	4.9	.8	5.7
49	42	66	53	78	88	81	86	89	122	126	122
4	4	9	4	7	15	7	8	12	17	25	9
8.2	9.5	13.6	7.5	9.0	17.0	8.6	9.3	13.5	13.9	19.8	7.4
	5	13	7	16	18	12	20	26	32	26	30
	11.9	19.7	13.2	20.5	20.5	14.8	23.3	29.2	26.2	20.6	24.6
1		1				1	1			1	
2.0		1.5				1.2	1.2			.8	
38	30					1	1				1
77.6	71.4					1.2	1.2				.8
3	1	41	34	49	48	51	51	40	66	70	73
6.1	2.4	62.1	64.2	62.8	54.5	63.0	59.3	44.9	54.1	55.6	59.8
3	2		5	2	1	3	1	3	2		
6.1	4.8		9.4	2.6	1.1	3.7	1.2	3.4	1.6		
								1			
								1.1			
		2	3	4	6	6	4	7	5	4	9
		3.0	5.7	5.1	6.8	7.4	4.7	7.9	4.1	3.2	7.4

TABLE B.10 Expected Primary Work Activity of Oceanography Ph.D.'s, 1958-1979

PRIMARY WORK ACTIVITY		YEAR OF DOCTORATE								
		1958	1959	1960	1961	1962	1963	1964	1965	1966
RESEARCH & DEVELOPMENT	N					10	12	13	17	18
	V					71.4	85.7	76.5	63.0	72.0
TEACHING	N					1		1	4	4
	V					7.1		5.9	14.8	16.0
ADMINISTRATION	N									
	V									
PROF. SERVICES TO INDIVS.	N									
	V									
OTHER	N					1		1	3	2
	V					7.1		5.9	11.1	8.0
R&D AND TEACHING	N					1	1	2	2	1
	V					7.1	7.1	11.8	7.4	4.0
R&D AND ADMIN.	N						1		1	
	V						7.1		3.7	
UNKNOWN ACTIVITY	N	13	8	5	8	1				
	V	100.0	100.0	100.0	100.0	7.1				
TOTAL ALL WORK ACTIVITIES	N	13	8	5	8	14	14	17	27	25

Data Source: Annual Census (NRC Survey of Earned Doctorates).

YEAR OF DOCTORATE

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
28	25	18	22	24	32	30	32	35	25	37	46	42
68.3	61.0	58.1	53.7	61.5	62.7	61.2	59.3	67.3	56.8	54.4	65.7	57.5
8	8	5	12	8	14	12	15	8	8	13	8	14
19.5	19.5	16.1	29.3	20.5	27.5	24.5	27.8	15.4	18.2	19.1	11.4	19.2
	2	2	1	4			2	1	3	5	4	4
	4.9	6.5	2.4	10.3			3.7	1.9	6.8	7.4	5.7	5.5
1			3	1	2	1	2	3	2	2	1	6
2.4			7.3	2.6	3.9	2.0	3.7	5.8	4.5	2.9	1.4	8.2
1	2		1	1	1	3	1		1	3	2	2
2.4	4.9		2.4	2.6	2.0	6.1	1.9		2.3	4.4	2.9	2.7
2	1	3	2		1	1			1		2	
4.9	2.4	9.7	4.9		2.0	2.0			2.3		2.9	
								1				1
								1.9				1.4
1	3	3		1	1	2	2	4	4	8	7	4
2.4	7.3	9.7		2.6	2.0	4.1	3.7	7.7	9.1	11.8	10.0	5.5
41	41	31	41	39	51	49	54	52	44	68	70	73

TABLE B.11 Expected Type of Employer of Oceanography Ph.D.'s, 1958-1979

		YEAR OF DOCTORATE											
POSTDOCTORAL TYPE OF EMPLOYER		1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
4-YEAR COLL/UNIV	N	5	6	4	5	4	5	12	13	11	19	18	15
	V	38.5	75.0	80.0	62.5	28.6	35.7	70.6	48.1	44.0	46.3	43.9	48.4
ELEM./SEC. SCHOOL	N											1	
	V											2.4	
U.S. FEDERAL GOVT	N	4	2		1	4	4	1	5	8	10	10	
	V	30.8	25.0		12.5	28.6	28.6	5.9	18.5	32.0	24.4	24.4	
STATE & LOCAL GOVT	N				1						1	1	3
	V				12.5						2.4	2.4	9.7
NON-PROFIT ORG.	N					1	2	1	2				
	V					7.1	14.3	5.9	7.4				
INDUSTRY & BUSINESS	N	2		1		2		2	2	3	6	1	4
	V	15.4		20.0		14.3		11.8	7.4	12.0	14.6	2.4	12.9
SELF EMPLOYED	N												1
	V												3.2
OTHER	N					1	1		1	1	1	3	
	V					7.1	7.1		3.7	4.0	2.4	7.3	
ALL FOREIGN	N	2			1	1	2	1	2	2	3	4	
	V	15.4			12.5	7.1	14.3	5.9	7.4	8.0	7.3	9.8	
NATIONAL GOVERNMENT	N												8
	V												25.8
UNKNOWN	N					1			2		[illegible]	3	
	V					7.1			7.4		2.4	7.3	
TOTAL	N	13	8	5	8	14	14	17	27	25	41	41	31

Data Source: Annual Census (NRC Survey of Earned Doctorates).

POSTDOCTORAL TYPE OF EMPLOYER		YEAR OF DOCTORATE									
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
4-YEAR COLL/UNIV	N	22	20	29	27	21	15	16	25	24	33
	V	53.7	51.3	56.9	55.1	38.9	28.8	36.4	36.8	34.3	45.2
MEDICAL SCHOOL	N										1
	V										1.4
JUNIOR COLLEGE	N					1	1	1	1		
	V					1.9	1.9	2.3	1.5		
ELEM./SEC. SCHOOL	N					1					
	V					1.9					
FOREIGN GOVT	N		2		2	2		3	4	5	2
	V		5.1		4.1	3.7		6.8	5.9	7.1	2.7
U.S. FEDERAL GOVT	N			5	7	16	14	14	15	13	9
	V			9.8	14.3	29.6	26.9	31.8	22.1	18.6	12.3
STATE & LOCAL GOVT	N		1	2	2	2	3	1	1		
	V		2.6	3.9	4.1	3.7	5.8	2.3	1.5		
U.S. STATE GOVT	N								1	4	2
	V								1.5	5.7	2.7
U.S. LOCAL GOVT	N								1		
	V								1.5		
NON-PROFIT ORG.	N	2	1	1	1		4		1	6	5
	V	4.9	2.6	2.0	2.0		7.7		1.5	8.6	6.8
INDUSTRY & BUSINESS	N	7	3	11	7	7	13	6	13	14	17
	V	17.1	7.7	21.6	14.3	13.0	25.0	13.6	19.1	20.0	23.3
SELF EMPLOYED	N					1			2	1	
	V					1.9			2.9	1.4	
OTHER	N					1					2
	V					1.9					2.7
NATIONAL GOVERNMENT	N	10	11								
	V	24.4	28.2								
UNKNOWN	N		1	3	3	2	2	3	4	3	2
	V		2.6	5.9	6.1	3.7	3.8	6.8	5.9	4.3	2.7
TOTAL	N	41	39	51	49	54	52	44	68	70	73

TABLE B.12 Sex, Citizen, and Race and Ethnic Group of Oceanography Ph.D.'s, 1958-1979

		YEAR OF DOCTORATE							
CITIZENSHIP, SEX & R/E GROUP		1958	1959	1960	1961	1962	1963	1964	1965
TOTAL DOCTORATES	N	14	8	6	8	14	15	18	29
CITIZENSHIP	N								
U.S. NATIVE	N	12	8	5	7	14	12	15	25
	V1	85.7	100.0	83.3	87.5	100.0	80.0	83.3	86.2
U.S. NATURALIZED	N								
	V1								
NON-U.S., IMMIGRANT	N			1				2	2
	V1			16.7				11.1	6.9
NON-U.S., NON-IMMIGRANT	N	2			1		3	1	2
	V1	14.3			12.5		20.0	5.6	6.9
UNKNOWN	N								
	V1								
SEX	N								
MALE	N	13	8	6	8	14	15	18	29
	V2	92.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0
FEMALE	N	1							
	V2	7.1							
RACIAL/ETHNIC GROUP	N								
AMERICAN INDIAN	N								
	V3								
ASIAN	N								
	V3								
BLACK	N								
	V3								
HISPANIC	N								
	V3								
WHITE	N								
	V3								
OTHER OR UNKNOWN	N								
	V3								

Data Source: Annual Census (NRC Survey of Earned Doctorates).

YEAR OF DOCTORATE

1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
39	48	49	42	66	53	78	88	81	86	89	122	126	122
33	44	40	33	60	44	68	73	65	70	72	102	103	101
84.6	91.7	81.6	78.6	90.9	83.0	87.2	83.0	80.2	81.4	80.9	83.6	81.7	82.8
		2	2	2	3	3	2	2	3	1	2	9	5
		4.1	4.8	3.0	5.7	3.8	2.3	2.5	3.5	1.1	1.6	7.1	4.1
1	1	1	1	1	3	3	5	7	5	5	5		2
2.6	2.1	2.0	2.4	1.5	5.7	3.8	5.7	8.6	5.8	5.6	4.1		1.6
3	2	6	5	3	3	3	7	6	7	9	12	14	13
7.7	4.2	12.2	11.9	4.5	5.7	3.8	8.0	7.4	8.1	10.1	9.8	11.1	10.7
2	1		1			1	1	1	1	2	1		1
5.1	2.1		2.4			1.3	1.1	1.2	1.2	2.2	.8		.8
39	47	48	39	64	52	77	84	73	83	75	116	112	112
100.0	97.9	98.0	92.9	97.0	98.1	98.7	95.5	90.1	96.5	84.3	95.1	88.9	91.8
	1	1	3	2	1	1	4	8	3	14	6	14	10
	2.1	2.0	7.1	3.0	1.9	1.3	4.5	9.9	3.5	15.7	4.9	11.1	8.2
									1			1	
									1.2			.8	
								2	5	7	8	3	9
								2.5	5.8	7.9	6.6	2.4	7.4
											1	1	2
											.8	.8	1.6
								1	2		1	4	5
								1.2	2.3		.8	3.2	4.1
								72	73	72	105	110	101
								88.9	84.9	80.9	86.1	87.3	82.8
								6	5	10	7	7	5
								7.4	5.8	11.2	5.7	5.6	4.1

OMB No. 099-RO294

1979 SURVEY OF DOCTORATE RECIPIENTS

CONDUCTED BY THE NATIONAL RESEARCH COUNCIL WITH THE SUPPORT OF THE NATIONAL SCIENCE FOUNDATION, THE NATIONAL ENDOWMENT FOR THE HUMANITIES, THE NATIONAL INSTITUTES OF HEALTH, AND THE DEPARTMENT OF ENERGY

NOTE: THIS INFORMATION IS SOLICITED UNDER THE AUTHORITY OF THE NATIONAL SCIENCE FOUNDATION ACT OF 1950, AS AMENDED. ALL INFORMATION YOU PROVIDE WILL BE TREATED AS CONFIDENTIAL AND USED FOR STATISTICAL PURPOSES ONLY. INFORMATION WILL BE RELEASED ONLY IN THE FORM OF STATISTICAL SUMMARIES OR IN A FORM WHICH DOES NOT IDENTIFY INFORMATION ABOUT ANY PARTICULAR PERSON. YOUR RESPONSE IS ENTIRELY VOLUNTARY AND YOUR FAILURE TO PROVIDE SOME OR ALL OF THE REQUESTED INFORMATION WILL IN NO WAY ADVERSELY AFFECT YOU.

If your name and address are incorrect, please enter correct information above. Include ZIP Code (79)

If there is an alternate address through which you can always be reached, please provide it on the line below.

C/O Number Street City State ZIP Code (80)

Please check the pre-printed information in questions 1 - 6 to be certain that it is correct and complete.

1. Date of Birth Mo. Day Year (10-14)

2. State or Foreign Country of Birth (15-16)

3. Citizenship 0 ☐ U.S.A. (17) 1 ☐ Non-U.S.A., specify country ________ (18-19)

4. Sex 1 ☐ M 2 ☐ F (20)

5. What is your racial background?

0 ☐ American Indian or Alaskan Native
1 ☐ Asian or Pacific Islander
2 ☐ Black
3 ☐ White
(21)

5a. Is your ethnic heritage Hispanic?

0 ☐ Yes
1 ☐ No
(22)

6. List in the table below all collegiate and graduate degrees, excluding honorary degrees, that have been awarded to you. Please check the pre-printed information, including the number and name of the specialty, from the Degree and Employment Specialties List on page 4, to be certain it is correct and complete.

Type of Degree	Granted Mo. Yr.	Major Field (Use Specialties List) Name Number	Institution Name City (or Campus) & State
Bachelor's			
Master's			
Doctorate			
Other, specify			

7. What is your marital status? 1 ☐ Married 2 ☐ Not married (including widowed, divorced) (10)

a. Do you have any children under 7 years of age? ☐ Yes ☐ No

b. Do you have any children between 7 and 18 years of age? ☐ Yes ☐ No (11)

8. Are you physically handicapped? 0 ☐ Yes 1 ☐ No If YES, enter number(s) from below ________ (12)

1. Visual 2. Auditory 3. Orthopedic 4. Other, specify ________ (13-16)

9. How many full-time equivalent years of professional work experience have you had? ________ Year(s) (17-18)

a. How many full-time equivalent years, if any, involved teaching? ________ Year(s) (19-20)

10. What was your employment status (includes postdoctoral appointment) during the week of FEBRUARY 11, 1979? ☐ Enter number from below (21)

1. Employed full-time
2. Employed part-time
   If you were employed part-time, were you seeking full-time employment? ☐ Yes ☐ No (22)
3. Postdoctoral appointment†

†Temporary appointment in academia, industry or government, the primary purpose of which is to provide for continued education or experience in research.

If you held a postdoctoral appointment, was it: ☐ Full-time ☐ Part-time (23)

4. Unemployed and seeking employment
5. Not employed and not seeking employment
6. Retired and not employed
7. Other, specify ______________________

If you selected categories 4, 5, or 6 in Question #10, you have completed the questionnaire. Please return this form in the enclosed envelope.

11. From the Degree and Employment Specialties List on page 4 select and enter both the number and title of the employment specialty most closely related to your principal employment or postdoctoral appointment during the week of FEBRUARY 11, 1979. Write in your specialty if it is not on the list.

____

Number Title of Employment Specialty (24-26)

12. If you were employed full-time during the week of FEBRUARY 11, 1979 in a specialty field other than your field of Ph.D., what was the MOST important reason for being in that position? ☐ Enter number from below (27)

1. Preferred position outside Ph.D. field
2. Promoted out of position in Ph.D. field
3. Better pay
4. Locational factors
5. Position in Ph.D. field not available
6. Other, specify ______________________

13. Please give the name of your principal employer (organization, company, postdoctoral institution, etc. or, if self employed, write "self") and actual place of employment during the week of FEBRUARY 11, 1979.

____

Name of Employer (28-33)

____

Number Street

____

City State ZIP Code (34-38)

14. Which category below best describes the type of organization of your principal employment OR postdoctoral appointment during the week of FEBRUARY 11, 1979? ☐ Enter number from below (39-40)

1. Business or industry (including self-employed)
2. Junior college, 2-year college, technical institute
3. Medical school (including university affiliated hospital or medical center)
4. 4-Year college
5. University, other than medical school
6. Elementary or secondary school system
7. Private foundation
8. Museum or historical society
9. Research library or archives
10. Hospital or clinic
11. U.S. military service, active duty, or Commissioned Corps, e.g., USPHS, NOAA
12. U.S. government, civilian employee
13. State government
14. Local or other government, specify: ______________________
15. Non-profit organization, other than those listed above
16. Other, specify ______________________

15. What percent of your professional work time did you devote to each of the following activities during the week of FEBRUARY 11, 1979?

%

Management & Administration of

1. __________ (41) Research and development
2. __________ (43) Educational programs
3. __________ (45) Other
4. __________ (47) Basic research
5. __________ (49) Applied research
6. __________ (51) Development of equipment, products, systems, data

%

7. __________ (53) Design
8. __________ (55) Teaching
9. __________ (57) Writing, editing
10. __________ (59) Professional services to individuals
11. __________ (61) Consulting
12. __________ (63) Production

%

13. __________ (65) Curatorial work
14. __________ (67) Performing arts
15. __________ (69) Quality control, inspection, testing
16. __________ (71) Sales, marketing, purchasing, estimating
17. __________ (73) Other, specify __________

Total = 100%

a. What were your primary and secondary work activities? (Enter number 1-17 from question #15 above) ☐ Primary (75-76) ☐ Secondary (77-78)

16. What was the basic annual salary* associated with your principal professional employment during the week of FEBRUARY 11, 1979? If you were on a postdoctoral appointment (see question #10 for definition), what was your stipend plus allowances? $ ______________ per year (10-12)

Check whether salary was for ☐ 9-10 months or ☐ 11-12 months (13)

*Basic salary is your annual salary before deductions for income tax, social security, retirement, etc., but does not include bonuses, overtime, summer teaching, or other payment for professional work.

17. What was your basic annual salary* for the year ending December 31, 1978? $ ______________ per year. (14-16)

Check whether salary was for ☐ 9-10 months or ☐ 11-12 months. (17)

a. What was your gross professional income for the year 1978?** $ ______________ (18-20)

**Gross professional income is all payments received for professional activities including basic salary before deductions plus bonuses, consulting fees, honoraria, royalties, rental and subsistence allowances, etc.

18. If you were employed by an academic institution during the week of FEBRUARY 11, 1979, did you hold a tenured position? 0 ☐ Yes 1 ☐ No (21)

If **YES**, what year was tenure granted? ______________ (22-23) If **NO**, did you hold a tenure-track position? 0 ☐ Yes 1 ☐ No (24)

19. If you were employed by an academic institution during the week of FEBRUARY 11, 1979, what was the rank of your position? ☐ Enter number from below (25)

FACULTY:

1. Professor
2. Associate professor
3. Assistant professor
4. Instructor
5. Other, specify ______________________________

NONFACULTY:

6. Teaching staff
7. Research staff
8. Other, specify ______________________________

20. Was any of your work during the week of FEBRUARY 11, 1979 supported or sponsored by U.S. Government funds?
0 ☐ Yes 1 ☐ No 2 ☐ Don't know (26)

If **YES**, which federal agencies or departments were supporting the work? ______________________________ (27-60)
(Enter the number(s) from the List of Federal Supporting Agencies on page 4)

21. Listed below are selected topics of critical national interest. If you devoted a proportion of your professional time which you considered significant to any of these problem areas during the week of FEBRUARY 11, 1979, please give the corresponding number of the ONE on which you spent the MOST time.

☐ Enter number from below (61-62)

1. Energy or fuel
2. Health
3. Defense
4. Environ. protection, pollution control
5. Education (other than teaching)
6. Space
7. Crime prevention and control
8. Food and other agricultural products
9. Natural resources, other than fuel or food
10. Community development and services
11. Housing (planning, design, construction)
12. Transportation, communications
13. Cultural life
14. Other area, specify ______________________

a. Please enter your BEST estimate of the percent of your professional time during the week of February 11, 1979 that was devoted to this area of national interest.

☐ Enter number from below (63)

1. 100 percent
2. 75 to 99 percent
3. 50 to 74 percent
4. 25 to 49 percent
5. 24 percent or less

If you selected energy or fuel (category #1) in question #21, please provide the information requested in items #22, #23 and #24.

22. From the list below, give the corresponding number of the ONE energy source that involved the LARGEST proportion of your energy-related work during the week of FEBRUARY 11, 1979. ☐ Enter number from below (64)

1. Coal and coal products
2. Petroleum (including oil shale and tar sands) or natural gas
3. Fission
4. Fusion
5. Hydroenergy
6. Direct solar (including space and water heating, thermal, electric)
7. Indirect solar (winds, tides, biomass, etc.)
8. Geothermal
9. Other, specify ______________________________

23. Please read the following list of energy-related activities and give the corresponding number(s) from the list below of the activity(ies) in which you were engaged during the week of FEBRUARY 11, 1979. Enter number(s) from below ______________ (65-78)

1. Exploration
2. Extraction (gas, oil, mining)
3. Manufacture of energy-related components or products
4. Fuel processing (including refining and enriching)
5. Electric power generation
6. Transportation, transmission, distribution of fuel or energy
7. Energy storage
8. Energy utilization, management
9. Fuel reprocessing or disposal
10. Energy conservation
11. Environmental impact (health, economic, etc.)
12. Education, training
13. Research and development
14. Other, specify ______________________________

24. Please enter the number 1-14 from item #23 that BEST describes the activity in which you spent MOST of your energy-related time. ☐ (79-80)

Thank you for completing this questionnaire. Please return the completed form in the enclosed envelope to the Commission on Human Resources, JH638, National Research Council, 2101 Constitution Avenue, Washington, D.C. 20418.

DEGREE AND EMPLOYMENT SPECIALTIES LIST

MATHEMATICAL SCIENCES

000 - Algebra
010 - Analysis & Functional Analysis
020 - Geometry
030 - Logic
040 - Number Theory
052 - Probability
055 - Math. Statistics (see also 544, 670, 725, 727)
060 - Topology
082 - Operations Research (see also 478)
085 - Applied Mathematics
088 - Combinatorics & Finite Mathematics
091 - Physical Mathematics
098 - Mathematics, General
099 - Mathematics, Other*

COMPUTER SCIENCES

071 - Theory
072 - Software Systems
073 - Hardware Systems
074 - Intelligent Systems
079 - Computer Sciences, Other (see also 437, 476)

PHYSICS & ASTRONOMY

101 - Astronomy
102 - Astrophysics
110 - Atomic & Molecular Physics
120 - Electromagnetism
130 - Mechanics
132 - Acoustics
134 - Fluids
135 - Plasma Physics
136 - Optics
1[illegible] - Thermal Physics
140 - Elementary Particles
150 - Nuclear Structure
160 - Solid State
198 - Physics, General
199 - Physics, Other*

CHEMISTRY

200 - Analytical
210 - Inorganic
215 - Synthetic Inorganic & Organometallic
220 - Organic
225 - Synthetic Organic & Natural Products
230 - Nuclear
240 - Physical
245 - Quantum
250 - Theoretical
255 - Structural
260 - Agricultural & Food
265 - Thermodynamics & Material Properties
270 - Pharmaceutical
275 - Polymers
280 - Biochemistry (see also 540)
285 - Chemical Dynamics
298 - Chemistry, General
299 - Chemistry, Other*

EARTH, ENVIRONMENTAL AND MARINE SCIENCES

301 - Mineralogy, Petrology
305 - Geochemistry
310 - Stratigraphy, Sedimentation
320 - Paleontology
330 - Structural Geology
341 - Geophysics (Solid Earth)
350 - Geomorph. & Glacial Geology
391 - Applied Geol., Geol. Engr. & Econ. Geol.
395 - Fuel Tech. & Petrol. Engr. (see also 479)
360 - Hydrology & Water Resources
370 - Oceanography
397 - Marine Sciences, Other*
381 - Atmospheric Physics & Chemistry
382 - Atmospheric Dynamics
383 - Atmospheric Sciences, Other*
388 - Environmental Sciences, General (see also 480, 528)
389 - Environmental Sciences, Other*
398 - Earth Sciences, General
399 - Earth Sciences, Other*

ENGINEERING

400 - Aeronautical & Astronautical
410 - Agricultural
415 - Biomedical
420 - Civil
430 - Chemical
435 - Ceramic
437 - Computer
440 - Electrical
445 - Electronics
450 - Industrial & Manufacturing
45[illegible] - Nuclear
460 - Engineering Mechanics
465 - Engineering Physics
470 - Mechanical
475 - Metallurgy & Phys. Met. Engr.
476 - Systems Design & Systems Science (see also 072, 073, 074)
478 - Operations Research (see also 082)
479 - Fuel Technology & Petrol. Engr. (see also 395)
480 - Sanitary & Environmental
486 - Mining
487 - Materials Science Engr.
498 - Engineering, General
499 - Engineering, Other*

AGRICULTURAL SCIENCES

500 - Agronomy
501 - Agricultural Economics
502 - Animal Husbandry
503 - Food Science & Technology (see also 573)
504 - Fish & Wildlife
505 - Forestry
506 - Horticulture
507 - Soils & Soil Science
510 - Animal Science & Animal Nutrition
511 - Phytopathology
518 - Agriculture, General
519 - Agriculture, Other*

MEDICAL SCIENCES

520 - Medicine & Surgery
522 - Public Health & Epidemiology
523 - Veterinary Medicine
524 - Hospital Administration
526 - Nursing
527 - Parasitology
528 - Environmental Health
534 - Pathology
535 - Pharmacology
537 - Pharmacy
538 - Medical Sciences, General
539 - Medical Sciences, Other*

BIOLOGICAL SCIENCES

540 - Biochemistry (see also 280)
542 - Biophysics
543 - Biomathematics
544 - Biometrics and Biostatistics (see also 055, 670, 725, 727)
545 - Anatomy
546 - Cytology
547 - Embryology
548 - Immunology
550 - Botany
560 - Ecology
562 - Hydrobiology
564 - Microbiology & Bacteriology
566 - Physiology, Animal
567 - Physiology, Plant
569 - Zoology
570 - Genetics
571 - Entomology
572 - Molecular Biology
573 - Food Science & Technology (see also 503)
574 - Behavior/Ethology
576 - Nutrition & Dietetics
578 - Biological Sciences, General
579 - Biological Sciences, Other*

PSYCHOLOGY

600 - Clinical
610 - Counseling & Guidance
620 - Developmental & Gerontological
630 - Educational
635 - School Psychology
641 - Experimental
642 - Comparative
643 - Physiological
650 - Industrial & Personnel
660 - Personality
670 - Psychometrics (see also 055, 544, 725, 727)
680 - Social
698 - Psychology, General
699 - Psychology, Other*

SOCIAL SCIENCES

700 - Anthropology
703 - Archeology
705 - Communications*
709 - Linguistics
710 - Sociology
720 - Economics (see also 501)
725 - Econometrics (see also 055, 544, 670, 727)
727 - Social Statistics (see also 055, 544, 670, 725)
740 - Geography
745 - Area Studies*
751 - Political Science
752 - Public Administration
755 - International Relations
770 - Urban & Regional Planning
775 - History & Philosophy of Science
798 - Social Sciences, General
799 - Social Sciences, Other*

HUMANITIES

802 - History & Criticism of Art
804 - History, American
805 - History, European
806 - History, Other*
808 - American Studies
809 - Theater & Theater Criticism
830 - Music
831 - Speech as a Dramatic Art (see also 885)
833 - Religion (see also 881)
834 - Philosophy
836 - Comparative Literature
891 - Library & Archival Sciences
878 - Humanities, General
879 - Humanities, Other*

LANGUAGES & LITERATURE

811 - American
812 - English
821 - German
822 - Russian
823 - French
824 - Spanish & Portuguese
826 - Italian
827 - Classical*
829 - Other Languages*

EDUCATION & OTHER PROFESSIONAL FIELDS

801 - Art, Applied
881 - Theology (see also 833)
882 - Business Administration
883 - Home Economics
884 - Journalism
885 - Speech & Hearing Sciences (see also 831)
886 - Law, Jurisprudence
887 - Social Work
897 - Professional Field, Other*
899 - Other Fields*

938 - Education (other than teaching in a field listed above)

*Identify the specific field in the space on the questionnaire.

LIST OF FEDERAL SUPPORTING AGENCIES (For use with #20)

1. Agency for International Development
2. Environmental Protection Agency
3. National Aeronautics & Space Administration
4. National Endowment for the Arts
5. National Endowment for the Humanities
6. National Science Foundation
7. Nuclear Regulatory Commission
8. Smithsonian Institution
9. Department of Agriculture
10. Department of Commerce
11. Department of Defense
12. Department of Energy
13. National Institutes of Health (DHEW)
14. Alcohol, Drug Abuse & Mental Health Administration (DHEW)
15. National Institute of Education (DHEW)
16. Office of Education (DHEW)
17. Other DHEW, specify ____________________
18. Department of Housing and Urban Development
19. Department of the Interior
20. Department of Justice
21. Department of Labor
22. Department of State
23. Department of Transportation
24. Other agency or department, specify ____________________
25. Don't know source agency

TABLE B.13 Sex, Race, Age, Year of Ph.D., and Citizenship of Ph.D. Scientists and Engineers, 1977

DEMOGRAPHIC CHARACTERISTICS	FIELD OF PH.D.								
	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.
TOTAL POPULATION	295827	1016	8562	17364	26425	44616	44329	75307	78208
SEX									
MALE	265377 89.7	961 94.6	8250 96.4	16089 92.7	25705 97.3	41668 93.4	44068 99.4	64854 86.1	63782 81.6
FEMALE	30450 10.3	55 5.4	312 3.6	1275 7.3	720 2.7	2948 6.6	261 .6	10453 13.9	14426 18.4
RACIAL GROUP									
WHITE/CAUCASIAN	263566 89.1	947 93.2	7994 93.4	15323 88.2	23357 88.4	40001 89.7	37285 84.1	67641 89.8	71018 90.8
MINORITY GROUP +	18986 6.4	41 4.0	307 3.6	1074 6.2	1515 5.7	2866 6.4	5412 12.2	4646 6.2	3125 4.0
NO REPORT	13275 4.5	28 2.8	261 3.0	967 5.6	1553 5.9	1749 3.9	1632 3.7	3020 4.0	4065 5.2
AGE IN SURVEY YEAR									
UNDER 30	8810 3.0	40 3.9	208 2.4	839 4.8	562 2.1	1456 3.3	897 2.0	2270 3.0	2538 3.2
30-34	54853 18.5	260 25.6	1375 16.1	4098 23.6	5068 19.2	7376 16.5	8073 18.2	13861 18.4	14742 18.8
35-39	67654 22.9	355 34.9	1660 19.4	4827 27.8	6768 25.6	9119 20.4	12164 27.4	16317 21.7	16444 21.0
40-44	45054 15.2	147 14.5	1594 18.6	2455 14.1	4240 16.0	6479 14.5	8827 19.9	10352 13.7	10960 14.0
45-49	37423 12.7	112 11.0	1283 15.0	1763 10.2	3226 12.2	5909 13.2	5505 12.4	9696 12.9	9929 12.7
50-54	30846 10.4	53 5.2	863 10.1	1339 7.7	2891 10.9	4624 10.4	3842 8.7	8376 11.1	8858 11.3
55-59	22794 7.7	25 2.5	726 8.5	789 4.5	1641 6.2	4191 9.4	2908 6.6	5864 7.8	6650 8.5
60-64	14221 4.8	11 1.1	348 4.1	597 3.4	953 3.6	3008 6.7	1169 2.6	4181 5.6	3954 5.1

Data Source: Biennial Survey of Doctorate Recipients.

FIELD OF PH.D.

DEMOGRAPHIC CHARACTERISTICS	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.
OVER 64	13727	13	504	651	1046	2404	891	4270	3948
	4.6	1.3	5.9	3.7	4.0	5.4	2.0	5.7	5.0
NO REPORT	445		1	6	30	50	53	120	185
	.2				.1	.1	.1	.2	.2
CALENDAR YEAR OF PH.D.									
1934-39	8265	3	318	401	758	2199	461	2416	1709
	2.8	.3	3.7	2.3	2.9	4.9	1.0	3.2	2.2
1940-44	8437	10	205	362	623	2546	644	2638	1409
	2.9	1.0	2.4	2.1	2.4	5.7	1.5	3.5	1.8
1945-49	9437		291	488	769	2550	892	2512	1935
	3.2		3.4	2.8	2.9	5.7	2.0	3.3	2.5
1950-54	24641	16	652	1078	2560	5038	2768	6526	6003
	8.3	1.6	7.6	6.2	9.7	11.3	6.2	8.7	7.7
1955-59	27620	30	889	1163	2549	5014	3076	7537	7362
	9.3	3.0	10.4	6.7	9.6	11.2	6.9	10.0	9.4
1960-64	37767	48	1300	2159	3975	6373	5601	9493	8818
	12.8	4.7	15.2	12.4	15.0	14.3	12.6	12.6	11.3
1965-69	65857	328	1745	4314	6371	9136	12822	15677	15464
	22.3	32.3	20.4	24.8	24.1	20.5	28.9	20.8	19.8
1970-74	88204	474	2256	5734	7109	9561	14445	22068	26557
	29.8	46.7	26.3	33.0	26.9	21.4	32.6	29.3	34.0
1975-76*	25599	107	906	1665	1711	2199	3620	6440	8951
	8.7	10.5	10.6	9.6	6.5	4.9	8.2	8.6	11.4
CITIZENSHIP									
U.S.	278246	967	8047	16167	24393	41900	39914	71094	75766
	94.1	95.2	94.0	93.1	92.3	93.9	90.0	94.4	96.9
FOREIGN	17064	49	514	1145	2012	2704	4372	4059	2209
	5.8	4.8	6.0	6.6	7.6	6.1	9.9	5.4	2.8
NO REPORT	515		1	52	20	12	43	154	233
	.2			.3	.1		.1	.2	.3

TABLE B.14 Geographic Location of Doctoral Ocean Scientists in 1973, 1975, and 1977 by Ph.D.-Year Cohorts

Ph.D. Year Cohort	Northeastern 1973	Northeastern 1975	Northeastern 1977	Central Atlantic 1973	Central Atlantic 1975	Central Atlantic 1977	South Atlantic 1973	South Atlantic 1975	South Atlantic 1977
Pre-1958									
Number	48	48	22	48	42	51	32	28	15
%	20.6	27.0	10.4	20.6	23.6	24.1	13.7	15.7	7.1
1958-65									
Number	52	59	70	71	91	88	23	12	13
%	18.8	20.0	25.4	25.7	30.8	31.9	8.3	4.1	4.7
1966-70									
Number	104	122	108	65	67	67	43	52	57
%	29.5	29.4	26.4	18.4	16.1	16.4	12.2	12.5	13.9
1971-72									
Number	38	29	54	33	17	13	25	24	6
%	17.5	15.3	24.0	15.2	9.0	5.8	11.5	12.7	2.7
1973-74									
Number		56	116		9	23		10	34
%		30.6	39.6		4.9	7.8		5.5	11.6
1975-76									
Number			51			5			22
%			43.2			4.2			18.6
Totals									
Number	242	314	421	217	226	247	123	126	147
%	22.4	24.9	27.5	20.1	17.9	16.1	11.4	10.0	9.6

Data Source: Biennial Survey of Doctorate Recipients.

Gulf Coast			Central			Pacific			Totals		
1973	1975	1977	1973	1975	1977	1973	1975	1977	1973	1975	1977
21	14	28	9	4	18	75	42	78	233	178	212
9.0	7.9	13.2	3.9	2.2	8.5	32.2	23.6	36.8	100	100	100
18	14	8	18	10	13	94	109	84	276	295	276
6.5	4.7	2.9	6.5	3.4	4.7	34.1	36.9	30.4	100	100	100
18	27	38	32	18	10	91	129	129	353	415	409
5.1	6.5	9.3	9.1	4.3	2.4	25.8	31.1	31.5	100	100	100
38	40	42	11	20	10	72	59	100	217	189	225
17.5	21.2	18.7	5.1	10.6	4.4	33.2	31.2	44.4	100	100	100
	00	13		16	20		92	87		183	293
	0.0	4.4		8.7	6.8		50.3	29.7		100	100
		12			00			28			118
		10.2			0.0			23.7			100
95	95	141	70	68	71	332	431	506	1079	1260	1533
8.8	7.5	9.2	6.5	5.4	4.6	30.8	34.2	33.0	100	100	100

TABLE B.15 Median Annual Salary of Scientists and Engineers by Age and Field, 1977

		FIELD OF EMPLOYMENT - 1977									
AGE IN 1977	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.	NONSC /UNK	NOT EMPL
TOTAL- ALL AGE GROUPS+	25600	24100	26200	24000	26400	26400	28500	24600	23800	27200	
UNDER 30	18300			17500	21400	20000	21300	18100	17900	16000	
30-34	20400	19200	20600	19600	20800	21300	24000	19500	19300	20900	
35-39	23700	23400	23900	23200	23800	24400	27200	22200	22100	24000	
40-44	26600	25600	25900	26100	27800	28100	29400	25200	24800	26700	
45-49	29400	29400	29300	30100	30500	30300	31300	27700	26600	30000	
50-54	31000		31800	32200	33100	32200	34000	30000	29800	30200	
55-59	31800		32500	31300	33900	32000	34600	30300	30500	34200	
60-64	31600		34500	31000	32900	34000	33800	30500	30600	33900	
OVER 64	31500		32900	33700	36500	29800	33100	30300	31200	35300	

NOTE: Median salaries were computed only for Ph.D.'s employed full-time, excluding those in the U.S. military. Academic salaries were multiplied by 11/9 to adjust for a full-year scale. Medians have not been calculated for cells with less than 20 cases reporting salary.
+ Includes those not reporting age.

TABLE B.16 Median Annual Salary of Scientists and Engineers by Type of Employer and Field, 1977

		FIELD OF EMPLOYMENT - 1977									
TYPE OF EMPLOYER	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.	NONSC /UNK	NOT EMPL
TOTAL- ALL EMPLOYERS	25600	24100	26200	24000	26400	26400	28500	24600	23800	27200	
EDUCATIONAL INSTITUTION	23600	23600	23500	22700	24400	22800	26400	23400	22600	25300	
4-YEAR COLLEGE/UNIV	23800	23600	23600	22800	24600	22900	26400	23500	22700	25700	
2-YEAR COLLEGE	20800			17800	20200	20600		20100	21100	23200	
ELEM/SEC SCHOOL	22200								23400	19900	
FEDERAL GOVERNMENT	29700	28300	31000	29600	29700	28900	29400	28200	31500	35700	
STATE/LOCAL GOVERNMENT	21700		20700			20300	21700	21400	22300	24100	
HOSPITAL/CLINIC	23500					26800		25700	23000		
OTHER NON-PROFIT ORG	27100		27700	30000	27200	25000	30000	24200	26600	25500	
BUSINESS/INDUSTRY	29900		28800	27100	29800	29500	29900	28700	32200	32500	
OTHER/NO REPORT	29100							25300	31200	39100	

NOTE: Median salaries were computed only for Ph.D.'s employed full-time, excluding those in the U.S. military. Academic salaries were multiplied by 11/9 to adjust for a full-year scale. Medians have not been calculated for cells with less than 20 cases reporting salary.

Data Source: Biennial Survey of Doctorate Recipients

TABLE B.17 Type of Employer of Scientists and Engineers by Field, 1977

FY OF DOCTORATE - TOTAL

FIELD OF EMPLOYMENT-1977

1977 EMPLOYER	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SCC. SCI.	NONSC /UNK
EMPLOYED POPULATION	276910	1533	10978	18644	17911	33236	42309	67570	61528	23201
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EDUCATIONAL INSTITUTION	158033	971	5088	13192	11158	13464	14817	45382	42016	11945
	57.1	63.3	46.3	70.8	62.3	40.5	35.0	67.2	68.3	51.5
4-YEAR COLLEGE/UNIV	151956	940	4990	12829	10842	12664	14711	44400	40066	10514
	54.9	61.3	45.5	68.8	60.5	38.1	34.8	65.7	65.1	45.3
2-YEAR COLLEGE	4342	13	87	317	312	712	106	911	1033	851
	1.6	.8	.8	1.7	1.7	2.1	.3	1.3	1.7	3.7
ELEM/SECND SCHOOL	1735	18	11	46	4	88		71	917	580
	.6	1.2	.1	.2		.3		.1	1.5	2.5
U.S. GOVERNMENT	23170	311	2168	950	2002	1795	3949	7268	3455	1272
	8.4	20.3	19.7	5.1	11.2	5.4	9.3	10.8	5.6	5.5
STATE/LOCAL GOV'T	5121	63	433	97	10	199	384	1368	2025	542
	1.8	4.1	3.9	.5	.1	.6	.9	2.0	3.3	2.3
HOSPITAL/CLINIC	8259			12	88	392	21	2392	5117	237
	3.0			.1	.5	1.2		3.5	8.3	1.0
OTHER NON-PROFIT ORG'N	8005	44	346	355	824	789	1388	1303	1847	1109
	2.9	2.9	3.2	1.9	4.6	2.4	3.3	1.9	3.0	4.8
BUSINESS/INDUSTRY	70618	130	2839	4003	3758	16498	21720	8911	6298	6461
	25.5	8.5	25.9	21.5	21.0	49.6	51.3	13.2	10.2	27.8
OTHER	2359	14	104	35	60	93	27	935	754	337
	.9	.9	.9	.2	.3	.3	.1	1.4	1.2	1.5
NO REPORT	1345				11	6	3	11	16	1298
	.5				.1					5.6

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.18 Type of Employer of Recent Graduates (1975-76) as Scientists and Engineers by Field of Employment, 1977

FY OF DOCTORATE - 1975,1976

		FIELD OF EMPLOYMENT-1977								
1977 EMPLOYER	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SCC. SCI.	NONSC /UNK
EMPLOYED POPULATION	32313	118	1255	2272	1673	2882	4079	8133	9852	2049
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EDUCATIONAL INSTITUTION	19111	50	559	1484	1003	1448	1445	5609	6306	1207
	59.1	42.4	44.5	65.3	60.0	50.2	35.4	69.0	64.0	58.9
4-YEAR COLLEGE/UNIV	17960	50	559	1401	961	1423	1444	5453	5793	876
	55.6	42.4	44.5	61.7	57.4	49.4	35.4	67.0	58.8	42.8
2-YEAR COLLEGE	803			75	42	25	1	151	279	230
	2.5			3.3	2.5	.9		1.9	2.8	11.2
ELEM/SECND SCHOOL	348			8				5	234	101
	1.1			.4				.1	2.4	4.9
U.S. GOVERNMENT	2565	17	252	100	168	144	435	809	551	89
	7.9	14.4	20.1	4.4	10.0	5.0	10.7	9.9	5.6	4.3
STATE/LOCAL GOV'T	930		94	11		4	40	202	476	103
	2.9		7.5	.5		.1	1.0	2.5	4.8	5.0
HOSPITAL/CLINIC	1520					18	2	297	1157	46
	4.7					.6		3.7	11.7	2.2
OTHER NON-PROFIT ORG'N	1109	21	6	65	137	129	94	206	339	112
	3.4	17.8	.5	2.9	8.2	4.5	2.3	2.5	3.4	5.5
BUSINESS/INDUSTRY	6626	28	330	607	354	1131	2063	827	893	393
	20.5	23.7	26.3	26.7	21.2	39.2	50.6	10.2	9.1	19.2
OTHER	353	2	14	5	11	8		183	130	
	1.1	1.7	1.1	.2	.7	.3		2.3	1.3	
NO REPORT	99									99
	.3									4.8

Data Source: Biennial Survey of Doctorate Recipients

TABLE B.19 Primary Work Activity of Scientists and Engineers by Field of Employment, 1977

FY OF DOCTORATE - TOTAL

FIELD OF EMPLOYMENT-1977

	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.	NONSC /UNK
TOTAL	276910	1533	10978	18644	17911	33236	42309	67570	61528	23201
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MANAGEMENT/ADMIN.	59265	375	2545	2337	2758	7779	13212	12042	9207	9010
	21.4	24.5	23.2	12.5	15.4	23.4	31.2	17.8	15.0	38.8
OF R&D	30386	271	1332	978	1968	5759	8291	6997	2873	1917
	11.0	17.7	12.1	5.2	11.0	17.3	19.6	10.4	4.7	8.3
OF OTHER THAN R&D	21533	76	916	1006	496	1362	3442	3507	4905	5823
	7.8	5.0	8.3	5.4	2.8	4.1	8.1	5.2	8.0	25.1
OF BOTH	7346	28	297	353	294	658	1479	1538	1429	1270
	2.7	1.8	2.7	1.9	1.6	2.0	3.5	2.3	2.3	5.5
RESEARCH & DEVELOPMENT	92731	789	4059	5693	8985	15237	16852	29181	9712	2223
	33.5	51.5	37.0	30.5	50.2	45.8	39.8	43.2	15.8	9.6
BASIC RESEARCH	43235	605	1883	2061	5075	6932	1629	19792	4596	662
	15.6	39.5	17.2	11.1	28.3	20.9	3.9	29.3	7.5	2.9
APPLIED RESEARCH	36115	173	1987	1501	3228	6638	8502	8529	4606	951
	13.0	11.3	18.1	8.1	18.0	20.0	20.1	12.6	7.5	4.1
DEVELOPMENT/DESIGN	13381	11	189	2131	682	1667	6721	860	510	610
	4.8	.7	1.7	11.4	3.8	5.0	15.9	1.3	.8	2.6
TEACHING	87041	253	3141	9555	5496	7943	8346	18370	28429	5508
	31.4	16.5	28.6	51.2	30.7	23.9	19.7	27.2	46.2	23.7
REPORT/OTHER TECH WRITING	5055	55	246	232	138	356	393	1441	1584	610
	1.8	3.6	2.2	1.2	.8	1.1	.9	2.1	2.6	2.6
CONSULTING	5897	29	308	285	134	201	1516	1097	1843	484
	2.1	1.9	2.8	1.5	.7	.6	3.6	1.6	3.0	2.1
PRODUCTION/INSPECTION	2154	10	130	83	55	515	528	482	120	231
	.8	.7	1.2	.4	.3	1.5	1.2	.7	.2	1.0
SALES/PROF. SERVICES	14103		90	83	118	534	459	2633	8731	1455
	5.1		.8	.4	.7	1.6	1.1	3.9	14.2	6.3
OTHER	4980	14	287	165	119	395	597	1400	900	1103
	1.8	.9	2.6	.9	.7	1.2	1.4	2.1	1.5	4.8
NO REPORT	5684	8	172	211	108	276	406	924	1002	2577
	2.1	.5	1.6	1.1	.6	.8	1.0	1.4	1.6	11.1

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.20 Primary Work Activity of Recent Graduates (1975-76) 1977 of Scientists and Engineers by Field of Employment, 1977

FIELD OF DOCTORATE-1977

	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.	NONSC /UNK
TOTAL	32313	118	1255	2272	1673	2882	4079	8133	9852	2049
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
MANAGEMENT/ADMIN.	2881	24	59	139	74	218	433	658	839	437
	8.9	20.3	4.7	6.1	4.4	7.6	10.6	8.1	8.5	21.3
OF R&D	1247	7	36	59	41	159	232	386	291	36
	3.9	5.9	2.9	2.6	2.5	5.5	5.7	4.7	3.0	1.8
OF OTHER THAN R&D	1275	17	23	45	11	59	153	155	476	336
	3.9	14.4	1.8	2.0	.7	2.0	3.8	1.9	4.8	16.4
OF BOTH	359			35	22		48	117	72	65
	1.1			1.5	1.3		1.2	1.4	.7	3.2
RESEARCH & DEVELOPMENT	14506	56	699	827	1291	2150	2547	4890	1765	281
	44.9	47.5	55.7	36.4	77.2	74.6	62.4	60.1	17.9	13.7
BASIC RESEARCH	7615	51	311	207	889	1311	303	3721	743	79
	23.6	43.2	24.8	9.1	53.1	45.5	7.4	45.8	7.5	3.9
APPLIED RESEARCH	5079	5	332	280	320	668	1455	1017	920	82
	15.7	4.2	26.5	12.3	19.1	23.2	35.7	12.5	9.3	4.0
DEVELOPMENT/DESIGN	1812		56	340	82	171	789	152	102	120
	5.6		4.5	15.0	4.9	5.9	19.3	1.9	1.0	5.9
TEACHING	9763	12	311	1155	251	383	678	1579	4649	745
	30.2	10.2	24.8	50.8	15.0	13.3	16.6	19.4	47.2	36.4
REPORT/OTHER TECH WRITING	604	22	32	11	16	15	32	208	206	62
	1.9	18.6	2.5	.5	1.0	.5	.8	2.6	2.1	3.0
CONSULTING	658		47	29	1		157	118	285	21
	2.0		3.7	1.3	.1		3.8	1.5	2.9	1.0
PRODUCTION/INSPECTION	260		38	20	12	54	52	79		5
	.8		3.0	.9	.7	1.9	1.3	1.0		.2
SALES/PROF. SERVICES	2416		5		8	5	64	289	1884	161
	7.5		.4		.5	.2	1.6	3.6	19.1	7.9
OTHER	578	4	41	26		26	61	181	145	94
	1.8	3.4	3.3	1.1		.9	1.5	2.2	1.5	4.6
NO REPORT	647		23	65	20	31	55	131	79	243
	2.0		1.8	2.9	1.2	1.1	1.3	1.6	.8	11.9

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.21 Employment Status of Scientists and Engineers by Field of Ph.D., 1977

1977 EMPLOYMENT STATUS	FIELD OF PH.D. TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.
TOTAL POPULATION	295827	1016	8562	17364	26425	44616	44329	75307	78208
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EMPLOYED FULL-TIME	260097	934	7692	16068	23371	38806	41940	62585	68701
	87.9	91.9	89.8	92.5	88.4	87.0	94.6	83.1	87.8
SCIENCE	238307	908	7284	15049	21341	35013	39388	59063	60261
	80.6	89.4	85.1	86.7	80.8	78.5	88.9	78.4	77.1
OTHER/UNKNOWN FIELD	21790	26	408	1019	2030	3793	2552	3522	8440
	7.4	2.6	4.8	5.9	7.7	8.5	5.8	4.7	10.8
EMPLOYED PART-TIME	7109	19	171	300	505	737	427	1653	3297
	2.4	1.9	2.0	1.7	1.9	1.7	1.0	2.2	4.2
SCIENCE	5974	19	152	250	411	618	385	1419	2720
	2.0	1.9	1.8	1.4	1.6	1.4	.9	1.9	3.5
OTHER/UNKNOWN FIELD	1135		19	50	94	119	42	234	577
	.4		.2	.3	.4	.3	.1	.3	.7
POSTDOCTORAL APPOINTMENT	9704	39	247	127	1200	1642	441	4875	1133
	3.3	3.8	2.9	.7	4.5	3.7	1.0	6.5	1.4
NOT EMPLOYED	15890	24	420	727	1141	2906	1124	5407	4141
	5.4	2.4	4.9	4.2	4.3	6.5	2.5	7.2	5.3
SEEKING EMPLOYMENT	3312	18	78	176	279	482	264	991	1024
	1.1	1.8	.9	1.0	1.1	1.1	.6	1.3	1.3
NOT SEEKING	2830	3	15	125	205	447	216	1168	651
	1.0	.3	.2	.7	.8	1.0	.5	1.6	.8
RETIRED	9748	3	327	426	657	1977	644	3248	2466
	3.3	.3	3.8	2.5	2.5	4.4	1.5	4.3	3.2
OTHER	501		10	35	33	62	66	167	128
	.2		.1	.2	.1	.1	.1	.2	.2
NO REPORT	2526		22	107	175	463	331	620	808
	.9		.3	.6	.7	1.0	.7	.8	1.0

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.22 Employment Status of 1971-1976 Ph.D. Scientists and Engineers by Field of Ph.D., 1977

FIELD OF PH.D.

1977 EMPLOYMENT STATUS	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.
TOTAL POPULATION	103361	536	2917	6618	7836	10322	16079	26120	32933
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EMPLOYED FULL-TIME	88279	467	2573	6220	6294	8386	15322	19804	29213
	85.4	87.1	88.2	94.0	80.3	81.2	95.3	75.8	88.7
SCIENCE	81956	441	2511	5812	5754	7731	14657	18961	26089
	79.3	82.3	86.1	87.8	73.4	74.9	91.2	72.6	79.2
OTHER/UNKNOWN FIELD	6323	26	62	408	540	655	665	843	3124
	6.1	4.9	2.1	6.2	6.9	6.3	4.1	3.2	9.5
EMPLOYED PART-TIME	2575	7	60	108	157	135	115	477	1516
	2.5	1.3	2.1	1.6	2.0	1.3	.7	1.8	4.6
SCIENCE	2276	7	48	99	120	119	113	453	1317
	2.2	1.3	1.6	1.5	1.5	1.2	.7	1.7	4.0
OTHER/UNKNOWN FIELD	299		12	9	37	16	2	24	199
	.3		.4	.1	.5	.2		.1	.6
POSTDOCTORAL APPOINTMENT	8760	39	236	127	1114	1438	392	4471	943
	8.5	7.3	8.1	1.9	14.2	13.9	2.4	17.1	2.9
NOT EMPLOYED	3082	23	38	142	211	308	156	1171	1033
	3.0	4.3	1.3	2.1	2.7	3.0	1.0	4.5	3.1
SEEKING EMPLOYMENT	1714	18	35	79	123	167	78	507	707
	1.7	3.4	1.2	1.2	1.6	1.6	.5	1.9	2.1
NOT SEEKING	1292	3	3	63	88	130	78	616	311
	1.2	.6	.1	1.0	1.1	1.3	.5	2.4	.9
RETIRED	76	2				11		48	15
	.1	.4				.1		.2	
OTHER	72			4	18	5		32	13
	.1			.1	.2			.1	
NO REPORT	593		10	17	42	50	94	165	215
	.6		.3	.3	.5	.5	.6	.6	.7

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.23 Employment Status of Scientists and Engineers by Field of Ph.D., 1975

		FIELD OF PH.D.							
1975 EMPLOYMENT STATUS	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.
TOTAL	266012	846	7664	15551	24448	42387	40182	67982	66952
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EMPLOYED FULL-TIME	235503	783	6979	14485	21405	36755	38116	57394	59586
	88.5	92.6	91.1	93.1	87.6	86.7	94.9	84.4	89.0
EMPLOYED F-T, NONSCI/ENG FLD*	800		13	57	146	219	81	106	178
	.3		.2	.4	.6	.5	.2	.2	.3
EMPLOYED PART-TIME	5448	4	219	198	259	746	405	1403	2214
	2.0	.5	2.9	1.3	1.1	1.8	1.0	2.1	3.3
EMPLOYED P-T, SEEKING F-T EMPL	1703	12	38	104	206	234	117	400	592
	.6	1.4	.5	.7	.8	.6	.3	.6	.9
POSTDOCTORAL APPOINTMENT	8144	18	104	112	1134	1724	375	3868	809
	3.1	2.1	1.4	.7	4.6	4.1	.9	5.7	1.2
UNEMPLOYED, SEEKING EMPLOYMENT	2477	25	72	86	376	423	267	661	567
	.9	3.0	.9	.6	1.5	1.0	.7	1.0	.8
NOT EMPLOYED, NOT SEEKING EMPL	2374	2	19	107	243	433	164	950	456
	.9	.2	.2	.7	1.0	1.0	.4	1.4	.7
RETIRED	8652	2	211	371	616	1716	597	2912	2227
	3.3	.2	2.8	2.4	2.5	4.0	1.5	4.3	3.3
OTHER	431			11	41	88	33	139	119
	.2			.1	.2	.2	.1	.2	.2
NO REPORT	480		9	20	22	49	27	149	204
	.2		.1	.1	.1	.1	.1	.2	.3

* INCLUDES ONLY THOSE EMPLOYED FULL-TIME IN A NONSCIENCE OR NONENGINEERING POSITION BECAUSE A SCIENCE OR ENGINEERING POSITION WAS UNAVAILABLE.

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.24 Employment Status of Scientists and Engineers by Field of Ph.D., 1973

	FIELD OF PH.D.								
1973 EMPLOYMENT STATUS	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.
TOTAL	233686	695	6830	13509	22061	39435	34780	60173	56203
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EMPLOYED FULL-TIME	203092	639	6090	12358	19238	33537	32546	50662	48022
	86.9	91.9	89.2	91.5	87.2	85.0	93.6	84.2	85.4
EMPLOYED F-T, NONSCI/ENG FLD*	622		13	16	112	184	67	101	129
	.3		.2	.1	.5	.5	.2	.2	.2
EMPLOYED PART-TIME	4122	7	94	129	264	554	228	1116	1730
	1.8	1.0	1.4	1.0	1.2	1.4	.7	1.9	3.1
EMPLOYED P-T, SEEKING F-T EMPL	1972	9	60	59	254	348	207	456	579
	.8	1.3	.9	.4	1.2	.9	.6	.8	1.0
POSTDOCTORAL APPOINTMENT	5650	8	124	72	834	1373	283	2452	504
	2.4	1.2	1.8	.5	3.8	3.5	.8	4.1	.9
UNEMPLOYED, SEEKING EMPLOYMENT	2510		64	169	293	619	271	559	535
	1.1		.9	1.3	1.3	1.6	.8	.9	1.0
NOT EMPLOYED, NOT SEEKING EMPL	1451		3	68	98	339	84	566	293
	.6			.5	.4	.9	.2	.9	.5
RETIRED	6888	2	196	329	525	1482	420	2143	1791
	2.9	.3	2.9	2.4	2.4	3.8	1.2	3.6	3.2
OTHER	2221	15	65	73	115	256	202	728	767
	1.0	2.2	1.0	.5	.5	.6	.6	1.2	1.4
NO REPORT	5158	15	121	236	328	743	472	1390	1853
	2.2	2.2	1.8	1.7	1.5	1.9	1.4	2.3	3.3

* INCLUDES ONLY THOSE EMPLOYED FULL-TIME IN A NONSCIENCE OR NONENGINEERING POSITION BECAUSE A SCIENCE OR ENGINEERING POSITION WAS UNAVAILABLE.

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.25 Ph.D. Field of Scientists and Engineers by Field of Employment, 1977

FIELD OF EMPLOYMENT-1977

FIELD OF PH D	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI.	MATH/ COMP. SCI.	PHYS/ ASTR.	CHEM	ENGR	LIFE SCI.	PSYCH SOC. SCI.	NONSC /UNK	NOT EMPL
TOTAL	295827	1533	10978	18644	17911	33236	42309	67570	61528	23201	18917
	100.0	.5	3.7	6.3	6.1	11.2	14.3	22.8	20.8	7.8	6.4
OCEANOGRAPHY,MARINE SCIENCES	1016	732	116		14	7		97		26	24
	100.0	72.0	11.4		1.4	.7		9.5		2.6	2.4
EARTH SCIENCES	8562	171	6767	44	92	32	265	251	61	427	454
	100.0	2.0	79.0	.5	1.1	.4	3.1	2.9	.7	5.0	5.3
MATHEMATICS,COMPUTER SCI	17364	5	77	13800	46	3	782	535	178	1069	869
	100.0		.4	79.5	.3		4.5	3.1	1.0	6.2	5.0
PHYSICS,ASTRONOMY	26425	128	1033	1296	15503	291	3681	812	180	2152	1349
	100.0	.5	3.9	4.9	58.7	1.1	13.9	3.1	.7	8.1	5.1
CHEMISTRY	44616	35	571	396	785	29438	2419	2999	172	3970	3431
	100.0	.1	2.2	.9	1.8	66.0	5.4	6.7	.4	8.9	7.7
ENGINEERING	44329	38	778	2380	1253	496	34545	526	188	2604	1521
	100.0	.1	1.8	5.4	2.8	1.1	77.9	1.2	.4	5.9	3.4
LIFE SCIENCES	75307	412	941	164	206	2946	336	59699	579	3830	6194
	100.0	.5	1.2	.2	.3	3.9	.4	79.3	.8	5.1	8.2
PSYCH,SOCIAL SCI	78208	12	295	564	12	23	281	2651	60170	9123	5077
	100.0		.4	.7			.4	3.4	76.9	11.7	6.5

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.26 Ph.D. Field of Scientists and Engineers by Field of Employment, 1975

FIELD OF EMPLOYMENT-1975

FIELD OF PH D	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI	MATH/ COMP SCI	PHYS/ ASTR	CHEM	ENGR	LIFE SCI	PSYCH /SCC SCI	NONSC /UNK	NOT EMPL
TOTAL	266012	1260	10477	15882	17362	32502	40521	62461	55185	15948	14414
	100.0	.5	3.9	6.0	6.5	12.2	15.2	23.5	20.7	6.0	5.4
OCEANOGRAPHY,MARINE SCIENCES	846	590	163			2	3	50		9	29
	100.0	69.7	19.3			.2	.4	5.9		1.1	3.4
EARTH SCIENCES	7664	190	6257	28	85	53	230	133	41	336	311
	100.0	2.5	81.6	.4	1.1	.7	3.0	1.7	.5	4.4	4.1
MATHEMATICS,COMPUTER SCI	15551	8	37	12893	70	3	703	319	120	803	595
	100.0	.1	.2	82.9	.5		4.5	2.1	.8	5.2	3.8
PHYSICS,ASTRONOMY	24448	106	1089	921	15091	289	3434	640	193	1387	1298
	100.0	.4	4.5	3.8	61.7	1.2	14.0	2.6	.8	5.7	5.3
CHEMISTRY	42387	25	900	233	772	29301	2537	2644	72	3194	2709
	100.0	.1	2.1	.5	1.8	69.1	6.0	6.2	.2	7.5	6.4
ENGINEERING	40182	35	721	1296	1216	494	32949	502	132	1749	1088
	100.0	.1	1.8	3.2	3.0	1.2	82.0	1.2	.3	4.4	2.7
LIFE SCIENCES	67982	306	995	89	124	2340	373	56043	450	2451	4811
	100.0	.5	1.5	.1	.2	3.4	.5	82.4	.7	3.6	7.1
PSYCH,SOCIAL SCI	66952		315	422	4	20	292	2130	54177	6019	3573
	100.0		.5	.6			.4	3.2	80.9	9.0	5.3

Data Source: Biennial Survey of Doctorate Recipients.

TABLE B.27 Ph.D. Field of Scientists and Engineers by Field of Employment, 1973

		FIELD OF EMPLOYMENT-1973									
FIELD OF PH D	TOTAL	OCEAN /MAR SCI	OTHER EARTH SCI	MATH/ COMP SCI	PHYS/ ASTR	CHEM	ENGR	LIFE SCI	PSYCH /SOC SCI	NONSC /UNK	NOT EMPL
TOTAL	233686	1079	8912	13834	16436	27590	33974	55326	44127	14180	18228
	100.0	.5	3.8	5.9	7.0	11.8	14.5	23.7	18.9	6.1	7.8
OCEANOGRAPHY,MARINE SCIENCES	695	427	105				9	88		34	32
	100.0	61.4	15.1				1.3	12.7		4.9	4.6
EARTH SCIENCES	6830	175	5439	48	78	51	232	91	33	234	449
	100.0	2.6	79.6	.7	1.1	.7	3.4	1.3	.5	3.4	6.6
MATHEMATICS,COMPUTER SCI	13509	9	74	11154	87	2	577	244	63	424	875
	100.0	.1	.5	82.6	.6		4.3	1.8	.5	3.1	6.5
PHYSICS,ASTRONOMY	22061	113	660	749	14301	259	2707	599	91	1223	1359
	100.0	.5	3.0	3.4	64.8	1.2	12.3	2.7	.4	5.5	6.2
CHEMISTRY	39435	39	799	223	739	25697	2051	3400	26	3022	3439
	100.0	.1	2.0	.6	1.9	65.2	5.2	8.6	.1	7.7	8.7
ENGINEERING	34780	48	648	1130	1082	542	27795	303	160	1623	1449
	100.0	.1	1.9	3.2	3.1	1.6	79.9	.9	.5	4.7	4.2
LIFE SCIENCES	60173	257	946	93	119	1027	339	49135	440	2431	5386
	100.0	.4	1.6	.2	.2	1.7	.6	81.7	.7	4.0	9.0
PSYCH,SOCIAL SCI	56203	11	241	437	30	12	264	1466	43314	5189	5239
	100.0		.4	.8	.1		.5	2.6	77.1	9.2	9.3

Data Source: Biennial Survey of Doctorate Recipients.

QUESTIONNAIRE FOR 1975 DIRECTORY OF U.S. MARINE SCIENTISTS

Return to:
Ocean Affairs Board
National Academy of Sciences
2101 Constitution Ave., N. W.
Washington, D. C. 20418

Name ______________________________

Title ______________________________

Business Address ______________________________

____

____

Office Telephone Number ______________________________

Birth Date ______________________________

In Chronological Order List

Degree (s)	Year	College/University

I. Please check the appropriate box(es) indicating the primary scientific area(s) that describe your area(s) of expertise.

A. BIOLOGY

(1) TYPE

☐ Systematics
☐ Physiology
☐ Microbiology
☐ Reproduction
☐ Morphology

☐ Ecology
☐ Molecular
☐ Behavior
☐ Development
☐ Fisheries

☐ Populations
☐ Productivity
☐ Medical
☐ Parasitology

Other ______________________________

(2) TAXONOMIC GROUP

☐ Micro-Algae
☐ Macro-Algae
☐ Protozoans
☐ Sponges
☐ Molluscs

☐ Worms
☐ Crustacea
☐ Echinoderms
☐ Elasmobranchs
☐ Bony Fish

☐ Reptiles
☐ Birds
☐ Mammals

Other ______________________________

B. GEOLOGY

☐ Tectonics
☐ Geomorphology
☐ Sediments
☐ Paleontology
☐ Mineralogy
☐ Petrology
☐ Volcanology
☐ Geochemistry
☐ Economic

Other ______________________________

C. CHEMISTRY

☐ Organic
☐ Radiochemistry
☐ Trace Elements
☐ Theoretical-Phys.
☐ Geochemistry
☐ Biochemistry

Other ______________________________

D. PHYSICS

☐ Descriptive
☐ Modeling
☐ Air-Sea Interaction
☐ Theoretical
☐ Acoustics
☐ Tides
☐ Optics
☐ Currents
☐ Ice
☐ Waves

Other ______________________________

E. GEOPHYSICS

☐ Geomagnetism
☐ Seismology
☐ Gravity

Other ______________________________

F. ENGINEERING

☐ Civil
☐ Chemical
☐ Aero-Engineering
☐ Mechanical
☐ Bio-Engineering
☐ Electrical/Electronics
☐ Naval

Other ______________________________

G. METEOROLOGY

☐ Climatology
☐ Air-Sea Interaction
☐ Forecasting

Other ______________________________

H. OTHER

____

____

II. Please check the appropriate box(es) that best describes the kind of work you are currently performing.

A. GENERAL AREAS

☐ Administration
☐ Teaching
☐ Research
☐ Development
☐ Consulting

Other ______________________________

B. SPECIFIC AREAS

☐ Instrumentation
☐ Legal
☐ Medical
☐ Military
☐ Mining
☐ Modeling
☐ Monitoring
☐ Submersibles
☐ Aquaculture
☐ Biometrics
☐ Corrosion
☐ Data Management
☐ Education
☐ Food Technology
☐ Fouling
☐ Gear Design
☐ Predictions
☐ Structures
☐ Organic Fuels
☐ Pollution

Other ______________________________

III. Is most of your work conducted in:

A. GENERAL AREA

☐ Coastal
☐ Estuarine
☐ Deep Water

B. SPECIFIC GEOGRAPHIC REGION *(e.g. Gulf of Mexico)*

____

IV. Please list significant papers or other publications you have authored or co-authored in the past two years: Append additional sheets if necessary. Give complete references.

Title ______________________________

Author(s) ______________________________

Journal (if appropriate) ______________________________

Date ______________________________

Title ______________________________

Author(s) ______________________________

Journal (if appropriate) ______________________________

Date ______________________________

V. Please list special interest or activities not otherwise covered in this inquiry.

____

TABLE B.28 Institutional Sources of Doctoral Oceanography-Employed by Year of Ph.D. 1958-1976

	YEAR OF DEGREE										
INSTITUTION	PRE-1958	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
ALABAMA, UNIVER CF								1			
ALASKA, UNIV CF									1		
ARIZONA STATE UNIV											
ARIZONA, UNIV OF									1	1	
ARKANSAS,U-FAYETTVLE			1	1							
AUBURN UNIVERSITY/AL										1	
BOSTON CCLLEGE/MA											1
BCSTON UNIVERSITY/MA								1			
BRIGHAM YCUNG U/UT									1		
BROWN UNIVERSITY/RI	5		1					1		1	
CAL INST TECHNOLCGY	6				2			1			
CALIF, U-BERKELEY	23		1	1	2	2	4	3	2	3	5
CALIF, U-DAVIS						1		1		1	
CALIF,U-IRVINE											
CALIF,U-LCS ANGELES	11		1	4	1	2			3	2	2
CALIF,U-RIVERSIDE											
CALIF, U-SAN DIEGO	13	4	3	4		1		2	8	9	3
CALIF,U-SANTA BARB											
CALIF,U-SANTA CRUZ											
CARNEGIE-MELLON U/PA									1		
CASE WESTRN RSRVE/CH						1					
CATHCLIC U AMER/DC	1										
CHICAGO, UNIV OF/IL	10			1		1		3	2	2	
CINCINNATI, U OF/CH	1		1								
CITY UNIV CF NY											
CLAREMNT GRAD SCH/CA											
CLEMSCN UNIV/SC											
COLCRADO STATE UNIV										2	
COLORADO,U-BCULDER										1	
COLUMBIA UNIV/NY	16	2		2		2		4	1	3	3
CONNECTICUT, UNIV CF									1		1
CORNELL UNIV/NY	13	1		2	1	3	3	4	1	2	
DELAWARE, UNIV OF	1					1		1			
DREXEL UNIVERSITY/PA											
DUKE UNIVERSITY/NC	5				1			1			2
EMORY UNIV/GA						1				1	
FLORIDA STATE UNIV	2	1			2	1		1	1	1	
FLORIDA, UNIV CF	2	1	1	1						1	
FORDHAM UNIV/NY											1
GEO WASHINGTON U/DC	3	1									
GEORGETOWN UNIV/DC						1					
GEORGIA INST TECH											
GEORGIA, UNIV OF			1				1		1		
HARVARD UNIV/MA	22		4	3		5	3	3	1	3	1
HAWAII, UNIV CF	1	1				1	2			2	2
HOUSTON, U OF/TX										1	
HOWARD UNIVERSITY/DC							1				
ILLINCIS INST TECH	2										1
ILL. U. URBANA-CHAMP	5	1	1	1	1	1	1	1	1	1	1
INDIANA U BLCOMNGTON	1					1	3				1
IOWA STATE UNIV	3				1	1		1		1	
IOWA, UNIVERSITY CF	1			1	1	1					
JOHNS HCPKINS U/MD	3			2		1	2		3	2	4
KANSAS, UNIV CF	2		2		1		1	2			
KENT STATE UNIV/OH											
LEHIGH UNIVERSITY/PA							2				
LOMA LINDA UNIV/CA	1										1
LA ST UNIV & AGM C	2	1							2	3	1
LOUISVILLE, U OF/KY									1		
MAINE, U-CRONO											
MARYLAND, UNIV OF	5				1			2		1	1
MASS INST TECHNOLOGY	10	1		2	2	1	3	3	4	4	4
MASS, U CF-AMHERST	1							1			
MIAMI, UNIV CF/FL						1	2	3	6	4	4
MICHIGAN STATE UNIV	1						1				
MICHIGAN, UNIV OF	6	3			5				3		
MINNESOTA,U-MINNEAPL	5										

TABLE cont'd

INSTITUTION	YEAR OF DEGREE PRE-1958	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
MISSISSIPPI STATE U										1	
MISSISSIPPI U-MED CT											
MISSOURI,U-COLUMBIA			1			1					1
MONTANA STATE UNIV											
NEW HAMPSHIRE, U CF							1				
NEW YORK UNIVERSITY	8	1	1	3					2		2
NC STATE U-RALEIGH			1								1
NC, U OF-CHAPEL HILL		1	1	1				4			2
NORTHWESTERN UNIV/IL	4										2
NOTRE DAME, U OF/IN											
NOVA UNIVERSITY/FL											
OAK RIDGE ASSOC U/TN								1			
OHIO STATE UNIV	3		1					1			1
OKLAHOMA STATE UNIV											
OKLAHOMA, U CF	1										1
OREGON STATE UNIV	3					1		1	4	4	7
OREGON, UNIV OF	1									1	
PENN STATE UNIV	4		1		1		3		1	1	1
PENNSYLVANIA, U CF	4		1								
PITTSBURGH, UNIV CF	1							1			1
POLYTECHNIC INST NY	1										
PRINCETON UNIV/NJ	5	1						1	2	2	1
PURDUE UNIVERSITY/IN	4			1		1				1	
RADCLIFFE C/MA	2										
RENSSELAER PCLY I/NY		1									
RHODE ISLAND, U CF						1		1	1	3	5
RICE UNIVERSITY/TX	2			1			2		3	1	
ROCHESTER,UNIV OF/NY	4										
ROCKEFELLER UNIV/NY											
RUTGERS UNIV/NJ	5	1	5	2		1			3		1
RUTGERS U-NEWARK/NJ	1										
ST JOHNS UNIV/NY											1
SMITH COLLEGE/MA											
SOUTH CAROLINA, U CF											
SOUTH FLORIDA, U CF											
SOUTHERN CALIF, U OF	5	1	1	1	1	2			1	3	2
SOUTHERN ILL UNIV											
SOUTHERN MISS, U CF											
STANFORD UNIV/CA	13	2	1	3		4	2	3	5	7	4
SUNY AT BUFFALO											1
SUNY AT STONY BROOK											
SUNY BRANCH UNK/NY											
STEVENS INST TECH/NJ											1
SYRACUSE UNIV/NY	1								1		
TENN, U-KNOXVILLE	1										
TEXAS A&M UNIVERSITY	4	3	1	1	3		1	2	1	5	1
TEXAS, U-AUSTIN	5	1		1		1			1		1
TEX U HLTH SCI-HOUST											
TULANE U OF LA											2
UTAH STATE UNIV									1		
UTAH, UNIV OF										1	
VA COMMONWEALTH UNIV											
VA POLY INST&STATE U											
VIRGINIA, UNIV OF		1									
WASHINGTON STATE U			1								
WASHINGTON UNIV/MO	1						2				
WASHINGTON, U OF	21	3	1	2	2	6	2	4	5	5	8
WAYNE STATE UNIV/MI	1										
WEST VIRGINIA UNIV											
WILLIAM & MARY, C/VA											
WISCONSIN,U-MADISON	16	1	2			3	1	2	1	1	1
WISCONSIN,U-MILWAUKE											
WYOMING, UNIV OF										1	
YALE UNIVERSITY/CT	14	1	1	3		1	2	2			
FOREIGN INSTS	37	4	3	8	9	5	12	9	9	6	10
UNKNOWN INST									1	1	1
TOTAL ALL INSTS	355	39	40	52	37	57	57	72	87	97	98

TABLE cont'd

INSTITUTION	1968	1969	1970	1971	1972	1973	1974	1975	1976	TOTAL 58-76	TOTAL ALL YEARS
	YEAR OF DEGREE										
ALABAMA, UNIVER CF										1	1
ALASKA, UNIV CF			1	1		1			1	5	5
ARIZONA STATE UNIV					1					1	1
ARIZONA, UNIV OF						2		2		6	6
ARKANSAS,U-FAYETTVLE						1				3	3
AUBURN UNIVERSITY/AL			1				2			4	4
BOSTON CCLLEGE/MA					1					2	2
BOSTON UNIVERSITY/PA		1								2	2
BRIGHAM YOUNG U/UT										1	1
BROWN UNIVERSITY/RI				1		2		1		7	12
CAL INST TECHNOLOGY				2						5	11
CALIF, U-BERKELEY		4	3	4	1	1			1	37	60
CALIF, U-DAVIS	1	4		1	1	1	2			13	13
CALIF,U-IRVINE				1						1	1
CALIF,U-LOS ANGELES		1			2		2			20	31
CALIF,U-RIVERSIDE	1									1	1
CALIF, U-SAN DIEGO	5	9	11	11	7	9	5	4	2	97	110
CALIF,U-SANTA BARB	1	5	1	1	1		1			10	10
CALIF,U-SANTA CRUZ			1				1		1	3	3
CARNEGIE-MELLON U/PA										1	1
CASE WESTRN RSRVE/CH		1	1	1		1				5	5
CATHOLIC U AMER/DC		1			1					2	3
CHICAGC, UNIV OF/IL		2	1	1	2	2				17	27
CINCINNATI, U OF/CH										1	2
CITY UNIV CF NY					1					1	1
CLAREMNT GRAD SCH/CA		1								1	1
CLEMSON UNIV/SC				1						1	1
COLORADO STATE UNIV				2					1	5	5
COLORADO,U-BOULDER			1	1						3	3
COLUMBIA UNIV/NY	5	2	6	2	3	2	4	1		42	58
CONNECTICUT, UNIV CF		1		1	1	2				7	7
CORNELL UNIV/NY	2		1	3	2	1				26	39
DELAWARE, UNIV OF	1		1	3	1	1				9	10
DREXEL UNIVERSITY/PA				1						1	1
DUKE UNIVERSITY/NC	1		1	3		1	2			12	17
EMORY UNIV/GA										2	2
FLORIDA STATE UNIV		3		8	6	1	1	2		28	30
FLORIDA, UNIV OF	1		4	1	3	1	1			15	17
FORDHAM UNIV/NY		1		1				1		4	4
GEO WASHINGTON U/DC		2	1	1	2	1	1	1		10	13
GEORGETOWN UNIV/DC										1	1
GEORGIA INST TECH		1								1	1
GEORGIA, UNIV OF	1		1	1			2	1		9	5
HARVARD UNIV/MA	1	6	4	4	1	2	1	1		43	65
HAWAII, UNIV OF		1	2	2	2	2		1		18	19
HOUSTON, U OF/TX					1					2	2
HOWARD UNIVERSITY/DC										1	1
ILLINOIS INST TECH										1	3
ILL, U, URBANA-CHAMP	2	2	2	1	1	1	1			20	25
INDIANA U BLOCMNGTCN		1								6	7
IOWA STATE UNIV										4	7
IOWA, UNIVERSITY CF				1						4	5
JOHNS HOPKINS U/MD	3	2	2	1	4	3	1			30	33
KANSAS, UNIV CF	1					1				8	10
KENT STATE UNIV/OH				1						1	1
LEHIGH UNIVERSITY/PA	1					1				4	4
LOMA LINDA UNIV/CA										1	2
LA ST UNIV & ACM C		1	1	1		3	1			14	16
LOUISVILLE, U OF/KY										1	1
MAINE, U-GRONC		2			1	1				4	4
MARYLAND, UNIV OF			3	1						9	14
MASS INST TECHNOLCGY	1	3	3	1	2	1		1		36	46
MASS, U OF-AMHERST	1				1					3	4
MIAMI, UNIV CF/FL	4	5	4	3	1	9	2	2		50	50
MICHIGAN STATE UNIV		1			1	1				4	5
MICHIGAN, UNIV OF	2	3	2	1	1	1		1		22	28
MINNESOTA,U-MINNEAPL	1	1			1					3	8

TABLE cont'd

INSTITUTION	YEAR OF DEGREE 1968	1969	1970	1971	1972	1973	1974	1975	1976	TOTAL 58-76	TOTAL ALL YEARS
MISSISSIPPI STATE U					1	1	2			5	5
MISSISSIPPI U-MED CT						1				1	1
MISSOURI,U-COLUMBIA		1								4	4
MONTANA STATE UNIV	1									1	1
NEW HAMPSHIRE, U OF		1	1		1					4	4
NEW YORK UNIVERSITY	2	2	1	5	2	3				24	32
NC STATE U-RALEIGH		3	2	5	1	3				16	16
NC, U OF-CHAPEL HILL		2	2	4	1	1	2	1		22	22
NORTHWESTERN UNIV/IL		2	1	1						6	10
NOTRE DAME, U OF/IN		1	1							2	2
NOVA UNIVERSITY/FL			1	1						2	2
OAK RIDGE ASSOC U/TN										1	1
OHIO STATE UNIV	1	1	1					1		7	10
OKLAHOMA STATE UNIV		1				1				2	2
OKLAHOMA, U OF	1									2	3
OREGON STATE UNIV	8	3		5	9	1	4	2		49	52
OREGON, UNIV OF	1			1		2	1			6	7
PENN STATE UNIV	2				1		2			13	17
PENNSYLVANIA, U OF	1									2	6
PITTSBURGH, UNIV OF	1		1	1	1					6	7
POLYTECHNIC INST NY		1								1	2
PRINCETON UNIV/NJ	1			1	1		1			11	16
PURDUE UNIVERSITY/IN										3	7
RADCLIFFE C/MA											2
RENSSELAER POLY I/NY				1			1			3	3
RHODE ISLAND, U OF	1	3	1	4	7	3	2	2		34	34
RICE UNIVERSITY/TX		2	1	2				1		13	15
ROCHESTER,UNIV OF/NY											4
ROCKEFELLER UNIV/NY					1					1	1
RUTGERS UNIV/NJ	1	1			1	1				17	22
RUTGERS U-NEWARK/NJ											1
ST JOHNS UNIV/NY										1	1
SMITH COLLEGE/MA				1						1	1
SOUTH CAROLINA, U OF	1			1	1			1		4	4
SOUTH FLORIDA, U OF				1						1	1
SOUTHERN CALIF, U OF	3	2	6		5	5	1			34	39
SOUTHERN ILL UNIV						1				1	1
SOUTHERN MISS, U OF									1	1	1
STANFORD UNIV/CA	3		1	2	3	2	1			43	56
SUNY AT BUFFALO										1	1
SUNY AT STONY BROOK			1							1	1
SUNY BRANCH UNK/NY			1							1	1
STEVENS INST TECH/NJ										1	1
SYRACUSE UNIV/NY										1	2
TENN, U-KNOXVILLE											1
TEXAS A&M UNIVERSITY	5	5	6	3	2	5	3	1	1	49	53
TEXAS, U-AUSTIN		6	2	2						15	20
TEX U HLTH SCI-HOUST					1					1	1
TULANE U OF LA				2						4	4
UTAH STATE UNIV			1	1						3	3
UTAH, UNIV OF										1	1
VA COMMONWEALTH UNIV		1								1	1
VA POLY INST&STATE U			1					1		2	2
VIRGINIA, UNIV OF						1				2	2
WASHINGTON STATE U			1							2	2
WASHINGTON UNIV/MO				1						3	4
WASHINGTON, U OF	3	9	8	10	13	4	4	3		92	113
WAYNE STATE UNIV/MI											1
WEST VIRGINIA UNIV					1	1				2	2
WILLIAM & MARY, C/VA	1	1		2	3		4	1		12	12
WISCONSIN,U-MADISON	2		2	7	3	3				29	45
WISCONSIN,U-MILWAUKE			1							1	1
WYOMING, UNIV OF										1	1
YALE UNIVERSITY/CT	2		1	2		3				18	32
FOREIGN INSTS	5	5	9	3	5	3	4	2		111	148
UNKNOWN INST	1		1	2	3	3		3		16	16
TOTAL ALL INSTS	83	120	114	141	120	104	62	38	8	1426	1781

Data Source: U.S. Directory of Marine Scientists.

TABLE B.29 Employment Sectors of Subfields of Doctoral Oceanography-Employed Scientists

		SUBFIELD OF OCEANOGRAPHY						
EMPLOYMENT SECTOR		BIOL	CHEM	PHYS	GEO/ GEOPHYS	ENGIN	OTHER	TOTAL
ACADEMIA	N	643	112	196	313	44	1	1309
	H	49.1	8.6	15.0	23.9	3.4	.1	100.1
	V	72.5	78.9	67.1	80.1	67.7	25.0	73.5
FEDERAL GOVT	N	180	22	86	66	17	1	372
	H	48.4	5.9	23.1	17.7	4.6	.3	100.0
	V	20.3	15.5	29.5	16.9	26.2	25.0	20.9
STATE GOVT	N	56	8	5	4		1	74
	H	75.7	10.8	6.8	5.4		1.4	100.1
	V	6.3	5.6	1.7	1.0		25.0	4.2
INDUSTRY	N	8		5	8	4	1	26
	H	30.8		19.2	30.8	15.4	3.8	100.0
	V	.9		1.7	2.0	6.2	25.0	1.5
TOTAL	N	887	142	292	391	65	4	1781
	H	49.8	8.0	16.4	22.0	3.6	.2	100.0
	V	100.0	100.0	100.0	100.0	100.1	100.0	100.1

Data Source: U.S. Directory of Marine Scientists.

TABLE B.30 Year of Ph.D. of Subfields of Doctoral Oceanography-Employed Scientists 1958-1976

		SUBFIELD OF OCEANOGRAPHY						
YEAR OF PHD		BIOL	CHEM	PHYS	GEO/ GEOPHYS	ENGIN	OTHER	TOTAL
1958	N	22	3	5	8	1		39
	H	56.4	7.7	12.8	20.5	2.6		100.0
	V	2.5	2.1	1.7	2.0	1.5		2.2
1959	N	21	3	6	8	2		40
	H	52.5	7.5	15.0	20.0	5.0		100.0
	V	2.4	2.1	2.1	2.0	3.1		2.2
1960	N	23	5	7	17			52
	H	44.2	9.6	13.5	32.7			100.0
	V	2.6	3.5	2.4	4.3			2.9
1961	N	23	1	4	9			37
	H	62.2	2.7	10.8	24.3			100.0
	V	2.6	.7	1.4	2.3			2.1
1962	N	29	4	7	13	4		57
	H	50.9	7.0	12.3	22.8	7.0		100.0
	V	3.3	2.8	2.4	3.3	6.2		3.2
1963	N	28	4	3	19	3		57
	H	49.1	7.0	5.3	33.3	5.3		100.0
	V	3.2	2.8	1.0	4.9	4.6		3.2
1964	N	31	5	11	23	2		72
	H	43.1	6.9	15.3	31.9	2.8		100.0
	V	3.5	3.5	3.8	5.9	3.1		4.0
1965	N	39	9	13	24	2		87
	H	44.8	10.3	14.9	27.6	2.3		99.9
	V	4.4	6.3	4.5	6.1	3.1		4.9
1966	N	42	8	17	24	5	1	97
	H	43.3	8.2	17.5	24.7	5.2	1.0	99.9
	V	4.7	5.6	5.8	6.1	7.7	25.0	5.4
1967	N	48	6	20	20	4		98
	H	49.0	6.1	20.4	20.4	4.1		100.0
	V	5.4	4.2	6.8	5.1	6.2		5.5
1968	N	43	6	11	21	2		83
	H	51.8	7.2	13.3	25.3	2.4		100.0
	V	4.8	4.2	3.8	5.4	3.1		4.7
1969	N	68	8	21	16	7		120
	H	56.7	6.7	17.5	13.3	5.8		100.0
	V	7.7	5.6	7.2	4.1	10.8		6.7
1970	N	53	9	24	26	2		114
	H	46.5	7.9	21.1	22.8	1.8		100.1
	V	6.0	6.3	8.2	6.6	3.1		6.4

Data Source: U.S. Directory of Marine Scientists.

TABLE cont'd

YEAR OF PHD		BIOL	CHEM	PHYS	GEO/ GEOPHYS	ENGIN	OTHER	TOTAL
		SUBFIELD OF OCEANOGRAPHY						
1971	N	65	12	32	27	4	1	141
	H	46.1	8.5	22.7	19.1	2.8	.7	99.9
	V	7.3	8.5	11.0	6.9	6.2	25.0	7.9
1972	N	54	7	24	27	7	1	120
	H	45.0	5.8	20.0	22.5	5.8	.8	99.9
	V	6.1	4.9	8.2	6.9	10.8	25.0	6.7
1973	N	49	10	22	18	5		104
	H	47.1	9.6	21.2	17.3	4.8		100.0
	V	5.5	7.0	7.5	4.6	7.7		5.8
1974	N	29	6	11	15	1		62
	H	46.8	9.7	17.7	24.2	1.6		100.0
	V	3.3	4.2	3.8	3.8	1.5		3.5
1975	N	23	2	4	9			38
	H	60.5	5.3	10.5	23.7			100.0
	V	2.6	1.4	1.4	2.3			2.1
1976	N	5	1	1	1			8
	H	62.5	12.5	12.5	12.5			100.0
	V	.6	.7	.3	.3			.4
PRE-1958	N	192	33	49	66	14	1	355
	H	54.1	9.3	13.8	18.6	3.9	.3	100.0
	V	21.6	23.2	16.8	16.9	21.5	25.0	19.9
1958-1962	N	118	16	29	55	7		225
	H	52.4	7.1	12.9	24.4	3.1		99.9
	V	13.3	11.3	9.9	14.1	10.8		12.6
1963-1967	N	188	32	64	110	16	1	411
	H	45.7	7.8	15.6	26.8	3.9	.2	100.0
	V	21.2	22.5	21.9	28.1	24.6	25.0	23.1
1968-1972	N	283	42	112	117	22	2	578
	H	49.0	7.3	19.4	20.2	3.8	.3	100.0
	V	31.9	29.6	38.4	29.9	33.8	50.0	32.5
1973-1974	N	78	16	33	33	6		166
	H	47.0	9.6	19.9	19.9	3.6		100.0
	V	8.8	11.3	11.3	8.4	9.2		9.3
1975-1976	N	28	3	5	10			46
	H	60.9	6.5	10.9	21.7			100.0
	V	3.2	2.1	1.7	2.6			2.6
ALL YEARS	N	887	142	292	391	65	4	1781
	H	49.8	8.0	16.4	22.0	3.6	.2	100.0

TABLE B.31 Work Activities of Subfields of Doctoral Oceanography-Employed Scientists (DOS) 1958-1978

		SUBFIELD OF OCEANOGRAPHY						
WORK ACTIVITIES		BIOL	CHEM	PHYS	GEO/ GEOPHYS	ENGIN	OTHER	TOTAL
ADMINISTRATION	N	220	21	61	93	12	1	408
	H	53.9	5.1	15.0	22.8	2.9	.2	99.9
	V	24.8	14.8	20.9	23.8	18.5	25.0	22.9
TEACHING	N	503	81	144	224	43	2	997
	H	50.5	8.1	14.4	22.5	4.3	.2	100.0
	V	56.7	57.0	49.3	57.3	66.2	50.0	56.0
RESEARCH	N	786	137	259	343	61	4	1590
	H	49.4	8.6	16.3	21.6	3.8	.3	100.0
	V	88.6	96.5	88.7	87.7	93.8	100.0	89.3
DEVELOPMENT	N	40	11	26	6	17	1	101
	H	39.6	10.9	25.7	5.9	16.8	1.0	99.9
	V	4.5	7.7	8.9	1.5	26.2	25.0	5.7
CONSULTING	N	126	13	38	38	23	1	239
	H	52.7	5.4	15.9	15.9	9.6	.4	99.9
	V	14.2	9.2	13.0	9.7	35.4	25.0	13.4
OTHER	N	23	2	1	5			31
	H	74.2	6.5	3.2	16.1			100.0
	V	2.6	1.4	.3	1.3			1.7
UNKNOWN	N	19	1	14	16	1		51
	H	37.3	2.0	27.5	31.4	2.0		100.2
	V	2.1	.7	4.8	4.1	1.5		2.9
# PERSONS	N	887	142	292	391	65	4	1781
	H	49.8	8.0	16.4	22.0	3.6	.2	100.0

Data Source: U.S. Directory of Marine Scientists.

Note: Vertical numbers and percentages will not total because many individuals specified more than one type of work activity.

TABLE B.32 Geographic Distribution of Directory Oceanographers

Northeast States

State	Ph.D.'s	Others	Total
Maine	12	1	13
New Hampshire	15	3	18
Vermont	1	0	1
Massachusetts	213	94	307
Rhode Island	42	15	57
Connecticut	32	29	61
New York	151	29	180
Subtotals (Percent)	466 (22%)	171 (12%)	637 (18%)

South Atlantic States

	Ph.D.'s	Others	Total
North Carolina	86	27	113
South Carolina	21	1	22
Georgia	27	3	30
Florida (Atlantic)	156	66	222
Puerto Rico	11	3	14
Virgin Islands	3	0	3
Subtotals (Percent)	304 (14%)	100 (7%)	404 (12%)

Central States

	Ph.D.'s	Others	Total
Ohio	4	2	6
Indiana	2	0	2
Michigan	6	1	7
Minnesota	1	0	1
Wisconsin	23	2	25
Illinois	11	0	11
Missouri	1	0	1
Oklahoma	4	1	5
Colorado	3	8	11
Arizona	6	0	6
Subtotals (Percent)	61 (3%)	14 (1%)	75 (2%)

Central Atlantic States

	Ph.D.'s	Others	Total
New Jersey	40	18	58
Pennsylvania	27	5	32
Delaware	25	1	26
Maryland	80	119	199
Washington, D.C.	133	386	519
Virginia	78	85	163
West Virginia	2	0	2
Subtotals (Percent)	385 (18%)	614 (44%)	999 (28%)

Gulf Coast States

	Ph.D.'s	Others	Total
Florida (Gulf)	77	40	117
Alabama	5	6	11
Mississippi	45	52	97
Louisiana	26	4	30
Texas	112	39	151
Subtotals (Percent)	265 (12%)	141 (10%)	406 (12%)

Pacific States

	Ph.D.'s	Others	Total
California	339	178	517
Oregon	56	6	62
Washington	133	115	248
Alaska	48	30	78
Hawaii	61	23	84
Canal Zone	8	1	9
Guam	5	1	6
Subtotals (Percent)	650 (31%)	354 (26%)	1004 (28%)
Grand Totals	2131 (60%)	1394 (40%)	3525 (100%)

Data Source: U.S. Directory of Marine Scientists.